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Located at North Haven, Connecticut, is the nucleus of the world-wide TMC complex. Here, centralized supervision guarantees the successful administration and production of all the diversified TMC products.

Also at North Haven is the Nucleonics division which provides sophisticated electronic equipment for use in Nuclear Physics and Radio-Chemical research. Illustrated is the newest TMC instrument for qualitative and quantitative analysis of Gamma Rays—the Gammascope Model 101. The Pulse Height Analyzer combines multi-channel and single-channel features in one spectrometer. This addition to the TMC product line is evidence of the forward thinking that maintains Technical Measurement Corporation's position as the leader in nuclear instrumentation.



TELEMETRICS, INCORPORATED
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TELEMETRICS INC



Located in Gardena, California, just outside of Los Angeles, is the wholly owned subsidiary of TMC. Telemetry, Inc., the leading manufacturer of solid-state, digital-telemetry ground equipment, has been responsible for the delivery of more universal, wide-range, high-speed PCM Decommutation Systems than any other manufacturer in the world. Systems have been delivered to N.A.S.A. for use on the Mercury, OGO, Saturn II, OSO, Saturn, SIC, OAO, Relay and Apollo programs.

Illustrated is the most widely accepted PCM Decommutation System developed—the Model 620. The system operates over a bit-rate range of one to one million pulses per second and is an example of the first completely digital servo phase-lock synchronizer. This product and others from Telemetry, Inc. are produced and marketed within the West Coast facility. This provides the most effective coverage of a market which has quadrupled in the past few years.



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Located in San Mateo, California, just outside of San Francisco, is the most specialized member of the TMC family. The Special Products Division develops advanced products and systems that extend the usefulness of existing TMC products. It also manufactures and markets solid-state detectors.

Illustrated are two solid-state detectors made of processed single crystals. These may be used for the analysis and spectroscopy of all types of nuclear radiation including fission products, protons, alpha particles, beta particles, gamma rays, and heavy ions. It is the research and development assistance available from operations like the Special Products Division that make the Technical Measurement Corporation the successfully integrated organization that it has become.





TECHNICAL MEASUREMENT CORPORATION

TMC

M NEMOTRON DIVISION

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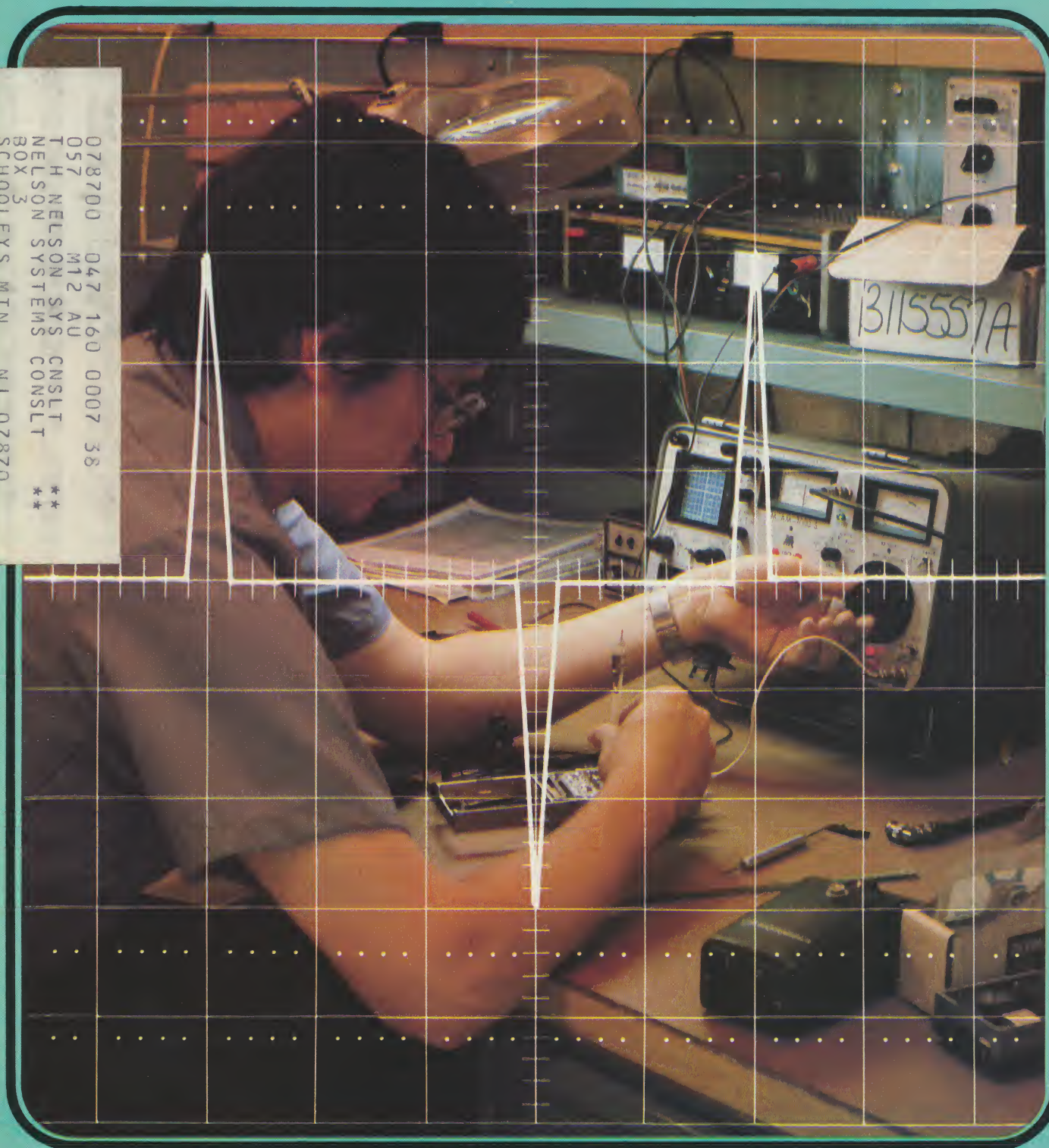
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Communications

The Authority in Land Mobile Radio

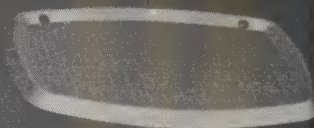
September 1979

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Test Equipment • Roberts on Spectrum Economics • 800 MHz Licensing

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announces the 125 watt, 450 MHz
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Model ASPA-1000
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(please print)

INFO/CARD 2

Communications

September 1979



Service Bench p. 28

FCC Form 400-S
June 1975

Form Approved
GAO No. B-180227 (R0185)

United States of America
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

SUPPLEMENTAL INFORMATION FOR
TRUNKED AND CONVENTIONAL SYSTEMS
(806-821 MHz and 851-866 MHz Bands)

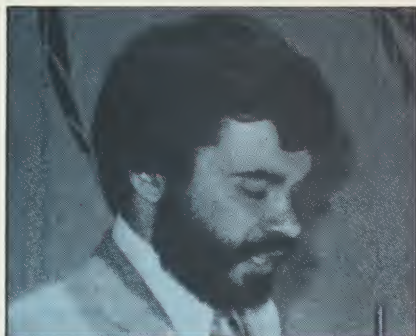
File No. _____

The following supplemental information is required when making application for Trunked or Conventional Systems of Communication to operate in the 806-821 MHz and 851-866 MHz frequency bands in accordance with the provisions of Subpart S of Part 89 of the Commission's Rules. For details as to the data to be furnished, refer to the instructions for each item.

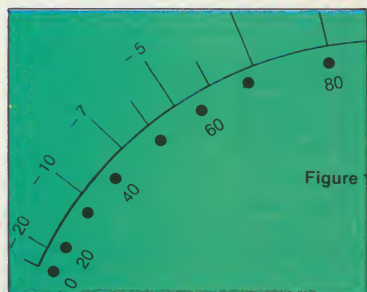
1. NAME OF APPLICANT (as given on FCC Form 400 or FCC Form 425):

2. Application is being made for (check one and complete where necessary):

800 MHz Licensing p. 44



Carlos Roberts p. 52



VU Meter p. 72

September Cover. At work at the service bench in the City of Aurora, Colorado's, RFI/EMI shielded enclosure is Craig Scherer, electronic technician. See related article, page 28.

1

Guest Comment. Ed Barnhill discusses the problems of a two-way radio shop that loses its trained technicians to higher paying, larger industries.

9

Setting Up a Service Bench. This article includes an equipment list with f.o.b. prices in order to present a realistic picture of what is involved when one starts a two-way service business.

28

Helpful Hints on 800 MHz Licensing. This is the first of a multi-part article on the preparation and the submission of license applications in the relatively new 800 MHz band.

44

The Economics of Spectrum Management. A concept that combines an initial auction of channels, followed by a free marketplace for the trading of operating rights on those channels, is explored by Carlos Roberts, chief, Private Radio Bureau of the FCC.

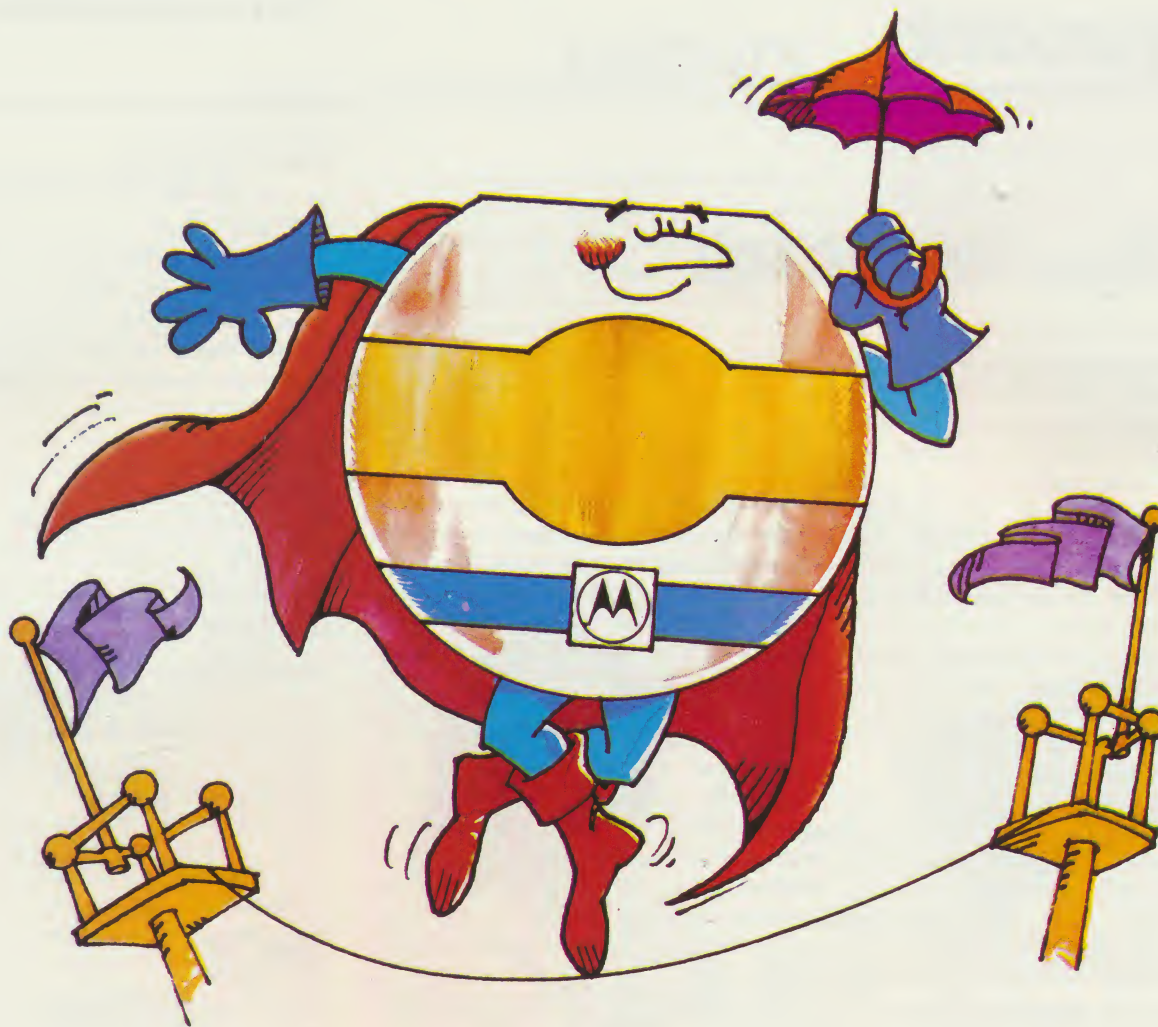
52

The VU Meter in Two-way Communications. An explanation of the use of a VU meter and how to interpret the reading of one is the subject of this article.

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Communications Group



INFO/CARD 3

An Eye for Detail

The development of an idea is similar to the development of a photograph. Planning and experimenting with film speeds, aperture settings, and processing time are required to produce the desired photograph. An idea or a theory also involves planning and detailed experiments to bring about the creator's end result.

Sometimes, a detail, not noticed by the naked eye, comes into sharp focus in the developed picture. Sometimes, ideas are like that — details aren't obvious in the first stage of development, but upon further examination, too many details (or the lack of them) may spoil the picture.

On page 52, Carlos Roberts, the FCC's chief of the Private Radio Bureau, presents his theory for spectrum management, a theory that many in the industry might find attractive — until they study the details.

Mr. Roberts uses a land market analogy to explain how a market for spectrum operating rights would work. He develops the analogy quite thoroughly; advantages for users, dealers, manufacturers, and frequency coordinating groups are spelled out in detail.

On the surface, the idea seems to have merit. Users can buy dormant licenses at a price they are willing to pay; frequency coordinating groups become brokers; dealers and manufacturers rake in more profits because users are buying more equipment. The FCC doesn't have to worry about making frequency assignment decisions because the market place does that for it. Everyone's happy.

But should everyone be? There seem to be a few details of the theory that have not been fully developed.

What is to prevent a large corporation from buying up all the spectrum to assure future market domination? Mr. Roberts says, "...the economic necessity to justify all expenditures of funds as investments...will keep the spectrum rights from being 'bought up' by large corporations."

In case that principle doesn't work, perhaps restrictions on ownership should be developed. That little detail is missing.

What protection does the user have against future changes in regulations for buying frequencies? Perhaps that detail should be worked out.

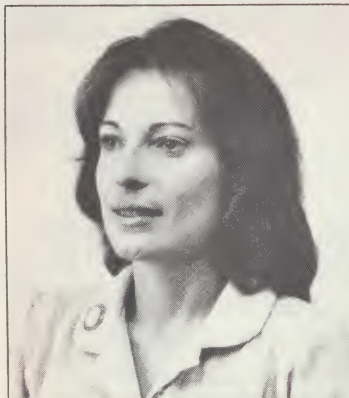
What's to prevent speculators from driving the prices up by buying and selling spectrum?

Is it good for the user that a dealer organization be a broker?

Will the public interest be served with the high bidders winning and the low bidders losing?

These comments and questions from the industry suggest that the spectrum economics picture is slightly out of focus. □

Barbara Green Martin



Barbara Martin, Managing Editor

Communications

Publisher

Phil D. Cook

Managing Editor

Barbara Green Martin

Associate Editor

Stephen Shaw

Editorial Assistant

Cindy Loftus

Editorial Adviser

William Detwiler

Production Manager

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Artists

Marjorie Asher

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Anthony Tyre

Deb Patterson

Composition

Tami Frazier

Dottie Johnson

Washington Correspondent

Arthur Hill

800 18th St., N.W., Suite 600

Washington, D.C. 20006

(202) 347-7027

Published by



Cardiff Publishing Company

Subsidiary of Cardiff Industries, Inc.

3900 So. Wadsworth Blvd.

Denver, Colo. 80235

(303) 988-4670

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West Coast Representatives

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Woodland Hills, Calif. 91367

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Communications

Letters

Equipment Needed

I am writing to request your assistance in our organization's drive to upgrade our current communications system. Due to our voluntary, non-tax supported structure, we have found it difficult to obtain new or used radio communications equipment.

Our current system consists of a mixed bag of member-owned PRS units with one GMRS occasionally available. Our desire is to obtain equipment compatible with local emergency dispatch centers so that we may implement an improved response capability.

To be compatible, requires either high band (154.13 MHz) or low band (33.70 MHz) FM mobiles and pagers. This equipment is often used by commercial systems on nearby frequencies.

We would greatly appreciate it if you would inform commercial users of our needs and the possible tax advantages that accompany the donation of used equipment to volunteer groups such as ours. It is our tax counsel's belief that such donations can have significant advantages over accepting the salvage value of usable equipment from a reconitioner.

Irvin Lichtenstein
Chief

Greater Philadelphia Emergency
Radio Team
704 Preston Rd.
Erdenheim, Pa. 19118
(215) 233-3360

Licensing Time

I would like to comment on your editorial in the July issue of *Communications Magazine*. In paragraph two of your article you quote what the FCC considers "acceptable time" and also what licensing time is now running in the various services. Looking at these items one is given the impression that things aren't really too bad; however, let us take a look at the "real" world once.

In reality, the times required for licensing differ considerably from that given. Let us take a rather typical license application that most

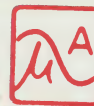
of your readers are probably familiar with, that of adding a customer to an existing community repeater that is already licensed and being used by other customers. Initially required is coordination which in this case is handled by NABER. Presently, this bottleneck will cost from six to eight weeks. After coordination is obtained, the license is then presented to the FCC. It now effectively lies in an incoming basket until such time as it is picked up and work begins on it. This dormant period normally runs 30 days for all types of licenses. Once it is picked up and work begun, a file number is assigned to it. It is at this "file number assigned" point that the FCC begins to count their processing time. Now let us slip back and add up the time it has taken to get only a file number assigned. Coordination of six to eight weeks plus four weeks awaiting file number equals ten to 12 weeks. The license is still a long way from being issued.

What I am trying to get across to you is, if the FCC gets their licensing time down to ten days without getting like reductions in time from NABER, SIRSA, etc., things are not being helped much. Also let us get rid of the 30 days dead time at the FCC, which is normally used for soliciting comments when broadcast licenses are applied for.

In closing, I believe that Carlos Roberts is headed in the correction direction and has a lot of innovative ideas; however, I was at the Denver National Business Radio Dealers Conference this year and personally heard and saw the reactions of both NABER and SIRSA when Roberts proposed point-of-sale licenses. Bureaucracies are not always limited to the government section.

J.C. Brand
Mayer Radio
Rapid City, S.D.

Apologies from the editor are due to Charles Albert, Applications Engineer, Setcom Corporation, for omitting his byline for the article, "A Vital Link," which appeared in the August issue of *Communications*. □

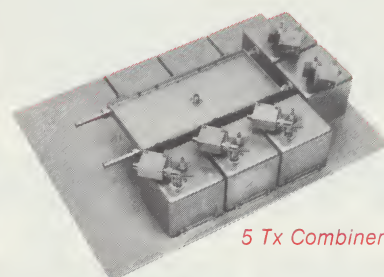


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Phone (604) 732-3342

Guest Comment

Now That You've Trained Him . . .

Ed Barnhill
Circle Communications Company

I am writing because I'm mad. I'm mad at DFW Airport, General Dynamics, Bell Helicopter, Missouri Pacific Railroad, the Federal Government, and other Big Business. I'm mad because they just hired another of my technicians that I spent the last eight months training. I'm mad because that is the third employee I have lost this week and all three went to Big Business.

As a two-way radio service company manager, I find that the biggest problem is not training technicians, but it is keeping them after I have trained them.

It has been our policy for many years to "grow our own" technicians. We have done this by hiring persons with some military or trade school training in electronics. We use this training as a basic building foundation on which to build a good two-way radio technician. After he is employed, we offer various training programs, such as the MTI Home Study Course, the Bell & Howell Two-Way Radio Servicing Course, and Motorola Mav-Paks, to him. We offer incentive salary increases as each training program is completed. This program, with help from our senior technicians, has worked satisfactorily in training other technicians.

Many two-way radio service companies use these same methods to train their technicians, not because it is the best way to train potential technicians, but rather because it is the only way available to many service companies. If you happen to be a two-way radio service company that is located in a state that has a college program that teaches extensive two-way radio repair, you are most fortunate. In many states, there are no such programs and no plans to implement any in the future. The Big Guns of two-way radio manufacturing are doing very little to insure a supply of technicians capable of servicing the complex two-way radio systems of the 80's.

So, the next eight months are spent training this potential technician. He learns how to do good installations in automobiles, trucks and pickups. He enjoys his work; he asks many questions; he studies many hours on his own. He gets his license, completes his MTI course — I am really pleased with his progress. I decide to promote him to field service technician, assign him a vehicle, and give him the

responsibility of \$10,000 worth of test equipment and parts. In the short time that he has been my employee, I have increased his salary by 50 percent. I am really pleased with his progress as well as the progress of my other technicians.

Then the bottom falls out. I feel as though it is all for nothing when my efforts result in this announcement: "The railroad has offered me a job at \$9 an hour. I'm sorry, but I can't pass up a deal like this one."

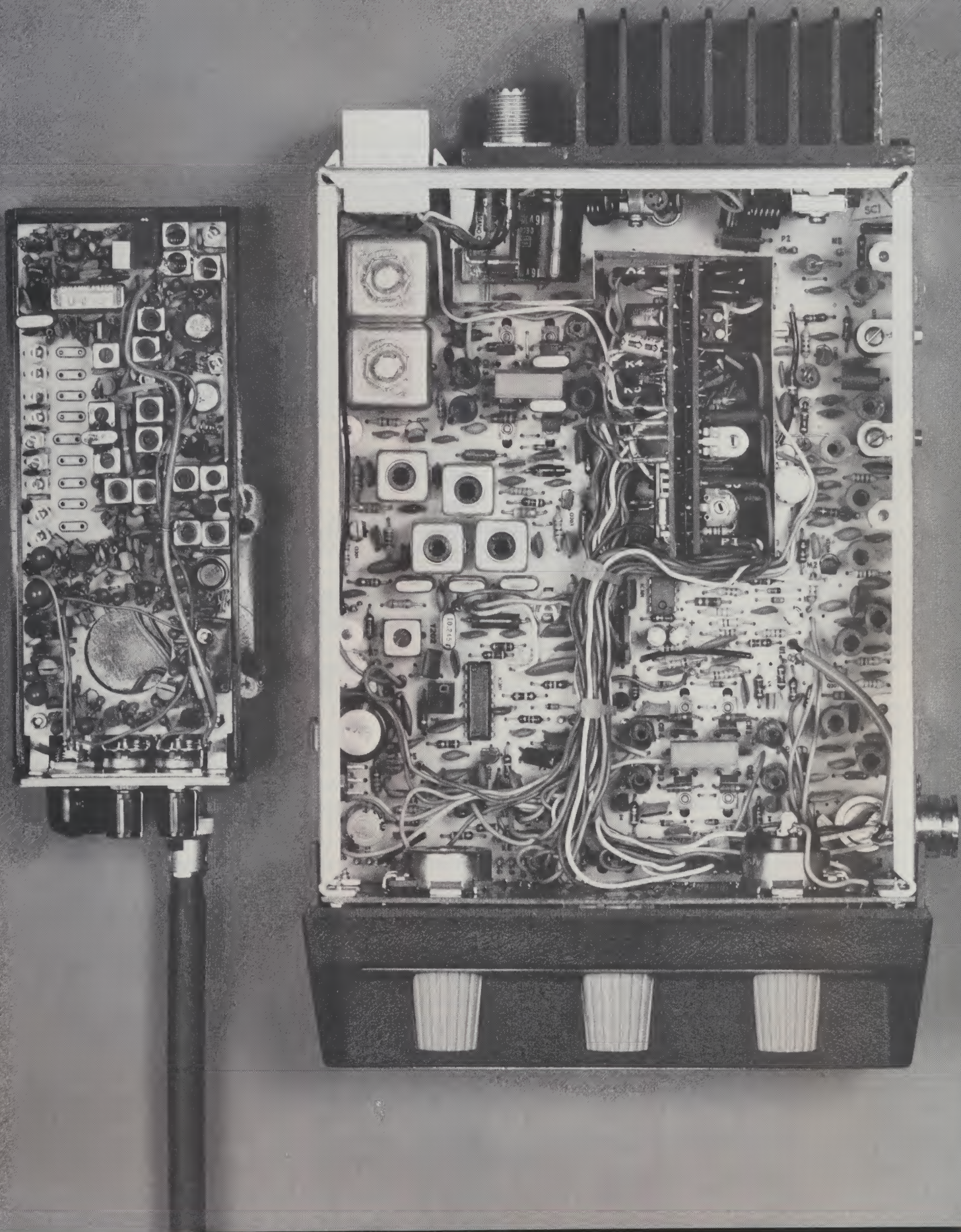
After I told the shop manager that we were losing another good technician, he replied, "It seems as though we are just a training field and supplier for other industries, most of which are government or government assisted."

I am not the only service manager to experience this situation. I am sure that it happens almost every day across these United States. The two most apparent problems of the two-way radio service station are: lack of trained two-way radio technicians and not being able to pay a competitive salary that will keep them in its employ. With the government paying \$12 an hour for cable splicers and the railroads paying \$9 an hour for technicians, can the two-way radio shop keep its technicians?

I believe that it can, and I believe that it can pay a competitive wage. A good two-way radio technician is a highly skilled person and deserves a good wage. He is going to demand it from you, the two-way radio repair shop owner, or from some other industry. There is a demand in the United States, at present, for approximately 400 good two-way radio technicians. Where will they come from? Who will train them? The two-way radio service companies will; and if we are to keep them, we must pay them a competitive wage, or we will lose a large percentage of them to Big Business. In order to pay a competitive wage, we must charge the two-way radio user more for our services.

As for Big Business, they could at least send us a thank-you card.

Ed Barnhill is vice president and service manager of Circle Communications Company in Fort Worth, Texas, where he began as an installer. He has been in the two-way service business for 17 years. □



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Yes.

We've spent a lot of time and money making sure one brand is. Here's why it is. And why it's important to you.

Money.

As a 2-way radio buyer, you're more interested in using radios than fixing radios. So it's important that the radios you use be well built. Easy, you say. There are some very expensive 2-way radios that are very well built. But with most costs going through the ceiling, it sure helps to economize. And if you can get the performance you need for less, why not? So where can you get well built inexpensive radios? Read on.

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At Regency we've built over 1.6 million FM Scanners. That means we buy a lot of resistors, capacitors, circuit boards . . . you name it. It also means the prices we pay for these parts are very low. Lower by a long shot than what some 2-way radio manufacturers pay to use the same parts in their radios. You don't need to be an expert in economics to see why we can offer a comparable radio for less. Yet our secret doesn't just end there.

Well Built Starts With Well Engineered.

We had one big advantage when we started in the 2-way radio business. We'd never done it before. So we didn't start from the high end and work down. Our radio was built from the ground up. And it even surprised us how many sacred cow ideas we could eliminate without changing the performance or the quality. That's not to say that *all* our radios will work *everywhere*. They weren't designed to. But then, for example, how often do you have a radio operating in the middle of a 3 million population city. Not much? Then keep on reading.

The Factory is the Main Factor.

Even a well designed radio doesn't stand a chance in a poorly run factory. That's not the case at our plant. The work's well organized, everyone knows their job, and they do it well. Plus we're highly mechanized. And what about quality control? We've got enough inspectors to field a small scale FBI. Our plant works, and so does our radio. But we'll soon be making some changes.

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You'll be seeing a lot of new things from Regency. Like even more of the results from our pioneering work in integrated circuits and microprocessor technology. There'll be other changes you probably won't see. For example, we'll have computers to sequence the components other computers will insert in circuit boards. Even with all these changes, though, you'll still be seeing more of the same from us: more high quality low cost radios.

Take Advantage.

We started with a well built little radio. We've come a long way since then. And we plan to go a lot farther. So if you're planning to buy Regency Radios, plan to take advantage. And if you're not considering us, we think you might want to change *your* plans.



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News

Land Mobile Excluded From New House Bill

According to sources on the staff of the House Communications Subcommittee, legislation being drafted to replace H.R. 3333, the so-called "Re-write" of federal communications law dumped for lack of support, will not include provisions relating to Land Mobile radio.

The old bill had included provisions regarding licenses, as well as sections requiring a spectrum use fee. The bill also authorized the federal government to seek new ways of improving spectrum efficiency through

the marketplace. Suggestions on how to accomplish this goal included spectrum management devices such as frequency auctions.

But the new bill, which subcommittee sources were predicting would be introduced by Chairman Lionel Van Deerlin by the end of July, was described by its drafters as common carrier legislation amending the 1934 Communications Act. Provisions related to broadcasting and private radio services were said to be purposely deleted from the new bill.

WARC Begins This Month

Amid predictions that it could become a foundation for a "new world information order," the World Administrative Radio Conference (WARC) is scheduled for September 24 to November 30 in Geneva, Switzerland.

The United States, together with over 160 other nations, all members of the International Telecommunications Union, will begin delicate negotiations that, once established, will provide the overall guidelines on how the radio spectrum will be allocated among existing and planned radio services. The conference, the first of its kind in 20 years, will last up to ten weeks.

The land mobile industry is hoping that one result of the conference will be a renewed atmosphere of cooperation between the United States and its neighbors, Canada and Mexico. In recent years, disputes over use of the UHF TV spectrum, as well as the 806-890 MHz band, especially along common borders, have resulted in serious crowding and congestion in the private radio services. Land mobile users in such metropolitan areas as Chicago and Detroit have been particularly hard hit because Canada requires an unusually large

amount of spectrum to meet its bilingual requirements in television broadcasting.

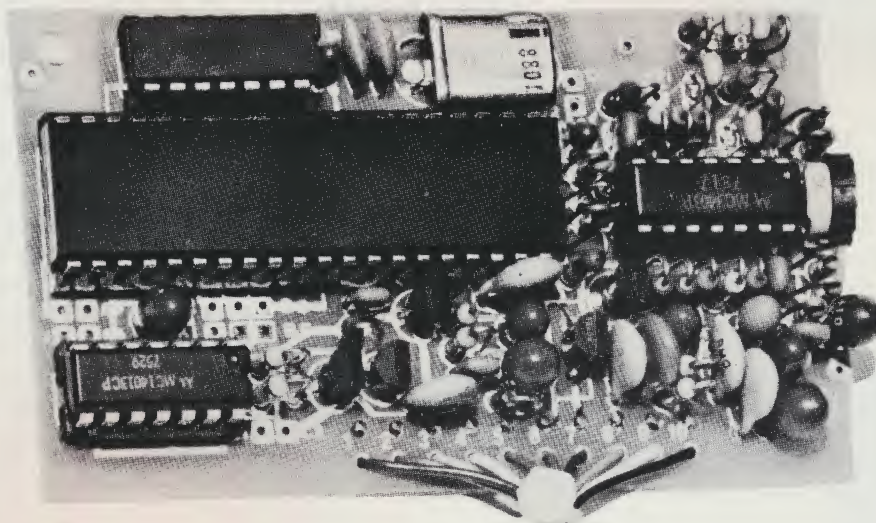
Land mobile groups appear to be satisfied with the position that the U.S. is taking into the conference, which includes sharing of the 806-890 MHz band among broadcasting, land mobile, and fixed services. (The FCC has stated that in the U.S. that primary allocations will go to land mobile with secondary use assigned to broadcasting.) The U.S. position also calls for "flexibility" in assignments of spectrum to land mobile and broadcasting in the UHF TV band, a position supported by land mobile.

Although some observers of WARC believe that the decision made during the conference will be binding on member nations for at least 20 years (when another WARC will be held), the U.S. State Department feels it is "highly improbable" that by the year 2000, that the decisions made in 1979 will have remained intact. Sources within the 64-member delegation point to the significant technological advances made during the period since the last WARC was held, adding that these advances have led to

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at least three international conferences on various portions of the worldwide table of radio allocations.

Chief among the strides telecommunications has made over the last two decades is the dramatic development of satellite communications, which few participants at the 1959 WARC envisioned. Today, a significant percentage of international communications is handled by satellite, and it is not surprising that many of the issues to be debated at the conference will center on the use of satellites as an even more significant international communications tool.

The present and contemplated satellite communications applications are so widespread that some planners envision the day when land mobile could utilize a satellite. One of the proposals the U.S. is planning to offer at the conference is an amendment to the table of allocations which would "allow for the consideration of" a land mobile satellite in the 806-890 MHz band. The proposal is being offered, according to sources familiar with the U.S. position, in the event that communications via satellite become economically and com-

mercially viable in the future. These sources say that such a service could provide "inexpensive two-way voice and data communications to a wide variety of local, state, and federal government users in mountainous or rural areas where such systems are not presently feasible."

Motorola Questions FCC 800 MHz Decision

Motorola, Inc., has filed a "partial" petition for reconsideration seeking a review of the FCC's decision to withhold additional 800 MHz frequencies for "conventional" land mobile systems.

The petition, which is directed at a bitterly contested decision approved by a split Commission last May, says that the FCC's action thwarts the intent of policies laid down in 1974, when channels in the 800 MHz band were first set aside for land mobile radio.

Motorola's outspoken opposition to that decision, coupled with its con-

cern over Commission actions to direct license applicants in congested areas away from conventional systems to other alternatives, has provoked an angry response from a chief competitor of Motorola, General Electric, which manufactures equipment for alternative systems.

In filing its petition, Motorola carefully stated it had no quarrel with provisions of the May decision increasing loading standards and reducing mileage separations for channels above 800 MHz. But it strongly objected to the FCC's failure to release more channels from the reserve pool and thereby "meet the current critical need for additional conventional land mobile radio licenses."

The petition called on the Commission to release 100 additional channels for conventional use. Motorola said that the additional channels, coupled with adoption of the proposed loading and separation standards, would provide a "reasonable transition to future trunked systems," a goal which the Commission said would also be achieved through the decision Motorola opposes.

Meanwhile, considerable contro-

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versy among users of the 800 MHz band seems to be accumulating at the Commission's door in the wake of its decision. While several of those who filed comments on the mileage and separation standards favored the FCC's suggestions, an equally vociferous group appear to oppose the suggestion based on the fact that substantial investments were made on the assumption that the technical standards would not be changed. In its filing, Sears, Roebuck, and Co., whose subsidiary, Fleet Maintenance, Inc., holds more than 290 licenses in the Business Radio Service, scored the Commission for its "retroactive application" of new standards. Sears said that the new loading standards would result in "saturation" of the 800 MHz band, a situation the FCC promised would not occur "because loading would be kept under control."

Another byproduct of the controversy surrounding the Commission's May decision has been an open rift between General Electric and Motorola. The debate is based on the Commission's decision to help meet the shortage of frequencies in the Chicago and Los Angeles areas by writing letters to applicants and advising them of alternatives, other than conventional land mobile services (such as SMR's). Motorola's Washington representative, Travis Marshall, reportedly wrote FCC Chairman Charles Ferris, objecting to the Commission's new policy in this regard and questioning whether this was a proper role of the government.

In response, GE's Donald Meyers, general manager of the company's Mobile Communications Operations and manufacturer of equipment for SMR systems, stated in part that Motorola has, in effect, led a "massive, orchestrated attack on the efficiency of trunked systems," adding that the efforts of the FCC's staff to encourage increased use of "spectrally efficient trunked systems" was consistent with Commission policy as enunciated in Docket 18262.

The dispute between GE and Motorola has led to the former's resignation from the Land Mobile Section of the Electronics Industries Association. GE's Meyers reportedly said the reason for GE's resignation was EIA's apparent refusal to remain neutral and its filing of comments favorable to Motorola.

September 1979

900 MHz Personal Radio Proposal

Representatives from several land mobile radio user groups have expressed several reservations regarding the FCC proposal to create a new personal radio service in the 900 MHz band.

The Commission, which announced it is seeking comment on the proposal through a Notice of Inquiry released late in June, said frequencies for the new service would come from

bands previously allocated to land mobile use. However, the Commission added in its notice that the impact of a new personal radio service on other private land mobile services "should be favorable in that it may result in reduced congestion in those services." The Commission also suggested that because of lower equipment costs (estimated to be in the \$300-\$500 range) and other factors, small business concerns might be interested in using a new service, as opposed to the traditional alternatives.

But some land mobile organizations

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doubted whether such a new service would catch on. Pointing to some of the more exotic suggestions the Commission offered as possible incentives to a new service, including private access to home computers, one land mobile spokesman said, "What do we need this for?" The source added that "Maybe I'm wrong, but I just don't see a market for that kind of thing."

Other sources were concerned about the impact that a new service, provided it could be interconnected, would have on the development of cellular radio. But such concerns are also of interest to the Commission, which asked those responding to its notice to address this issue.

The Commission said that its reasons for selecting the 900 MHz band for a new service included the fact that although presently allocated to land mobile, there are presently no licensees operating there. Additionally, the Commission noted that more spectrum for allocation in the band was available, and that approval from Mexican and Canadian authorities could be "more easily obtained."

Comments on the proposed new service are due by the first of November.

TV Industry Hits TI Receiver Performance

The nation's television and broadcasting industries have seriously questioned the need for a prototype television receiver designed to improve the technical performance of television sets and lead to improved spectrum efficiency in the UHF band.

The receiver was built by Texas Instruments under a Federal Communications Commission contract.

The Commission is conducting an inquiry on the receiver aimed at determining whether the receiver or the technical standards it has achieved should be required for all television sets.

If the high performance receiver is approved for mass production, proponents say it could lead to a reduction of the so-called "taboos" in the UHF band, resulting in more frequency allocations for other users of the spectrum, including land mobile.

In comments filed with the Federal Communications Commission, several television manufac-

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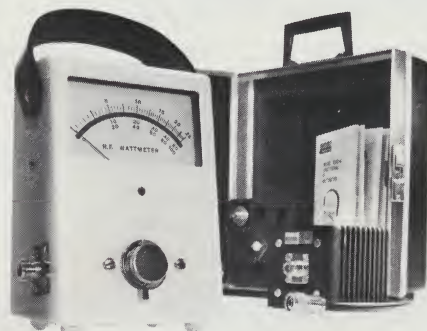
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Transportation

☐ 11. Land Transportation Services

☐ 12. Railroads

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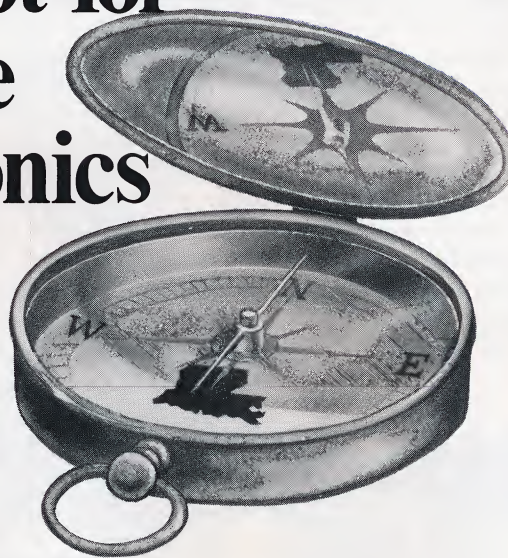
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The cost associated with operating a new marine electronics plant in Louisiana was compared by Fantus with operating an identical plant at representative locations in New York, California, and Texas. Based upon a facility generating \$20 million in annual sales, the estimated variable operating cost savings achievable in Louisiana is a high of over \$2 million annually.

The report is not theoretical. It is based on sound location strategies that manufacturers are adopting to cope with changing geographic and economic conditions in the marine electronics industry.

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will be distributed overseas via KLM Airlines. Its intended audience will be overseas businesses and government agencies using mobile radio and overseas agents, distributors, and sales/service organizations involved in mobile radio.

The first edition of *Global Communications* will be published in September, 1979. Subsequent editions will be published quarterly.

For a free copy of Fantus study, complete and return coupon to:

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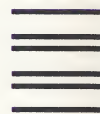
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turers and broadcaster organizations questioned the need for the new receiver, concentrating primarily on its costs. The National Association of Broadcasters (NAB) noted that the cost of the new receiver, compared to the "small improvements" which would result, did not make it cost effective. The NAB also noted that because of the design life of new television sets, it would take ten years before the new receiver could have an appreciable impact on spectrum efficiency.

Zenith, a major television manufacturer, also criticized the Commission's effort in this area, stating that Texas Instruments "is not a television receiver manufacturer and is totally inexperienced in engineering design and mass production in this field." The company added that the experimental receiver was designed and constructed without consulting anyone in the industry, and that by its own admission, Texas Instruments did not comply with present FCC rules regarding UHF noise figures.

Reply comments on the first round of filings were due by September 1. If the Commission is persuaded to continue its interest in the receiver, it could propose a rulemaking requiring the new receivers to be installed in all new television sets.

Cardiff Enters International Publishing Market

A new publication designed to promote export sales of North American land-mobile radio products has been announced by Cardiff Publishing Company (CPC), a Denver-based company which publishes national and international trade magazines, (one of which is *Communications Magazine*).

The publication, *Global Communications*, will feature coverage of mobile radio products and technology and will be distributed overseas via KLM Airlines. Its intended audience will be overseas businesses and government agencies using mobile radio and overseas agents, distributors, and sales/service organizations involved in mobile radio.

The first edition of *Global Communications* will be published in September, 1979. Subsequent editions will be published quarterly.

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Geographic Sharing Proposed

The FCC has proposed an amendment to its rules to provide for geographic sharing of frequencies in the petroleum, forest products, special industrial, and manufacturers radio services.

The proposed rulemaking is in response to a petition filed jointly by the American Petroleum Institute, Forest Industries Telecommunications, Inc. (FIT), and the Special Industrial

Radio Service Association (SIRSA).

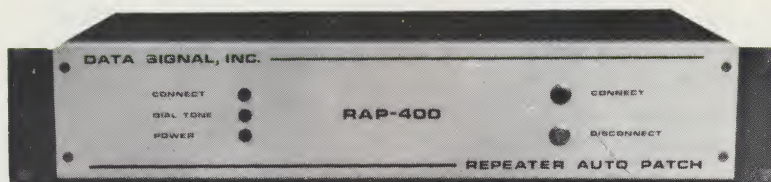
The FCC sought comment on whether SIRSA licensees in the north central state be allowed to use frequencies in the 30-50 and 150-160 MHz bands, which are presently allocated to the petroleum, forest products, and manufacturers radio services. The proposal also asked for comment on whether petroleum radio service users in the Texas-Louisiana Gulf Coast Area should be allowed to use frequencies assigned to SIRSA users.

Finally, the proposal suggested that FIT users in the Pacific Northwest

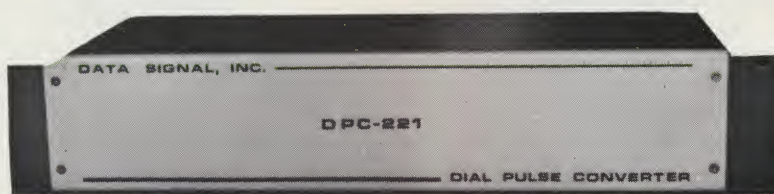
be allowed to use frequencies in the 30-50 MHz band presently allocated to SIRSA users.

The Commission, while pointing out that it encouraged interservice and geographic sharing plans, said it was concerned that there was no reciprocal frequency use for users of the manufacturers radio service suggested by any of the organizations which submitted the petition. The proposed rulemaking indicated the Commission wanted to explore this matter further, asking those who commented to address this issue.

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Coordination Fees Adjusted

Prompted by a recent FCC decision simplifying licensing procedures, the National Association of Business & Educational Radio (NABER) is adjusting its coordination fees, effective August 1, 1979.

The FCC's decision, which amended parts 2 and 90 of the rules, allows mobile relay, control, and mobile stations to be included on one application form (Form 400 or 425) and to be assigned one license and one call sign.

The new NABER fees will be as follows: \$20 for the first line and \$10 for each additional line completed on the NABER coordination form.

Call the NABER office (202) 659-8334 for further information on the adjusted fee structure.

Assignment Method Changed

The FCC has modified its procedures for assigning frequencies in the 806-866 MHz band for trunked radio systems, as of August 27, 1979.

The procedure adopted would divide the 200 channels now allocated for trunked systems into ten 20-channel blocks, with 10-channel spacing between frequencies within the block, while arranging each 20-channel block into 5-channel groups, with 40-channel spacings between successive frequencies in each 5-channel group. In addition, the Commission said, these 5-channel groups would be arranged into four blocks, with 20-channel spacings and one 10-channel spacing between 5-channel groups, and would offset successive 20-channel blocks by one channel to form ten 20-channel blocks. □

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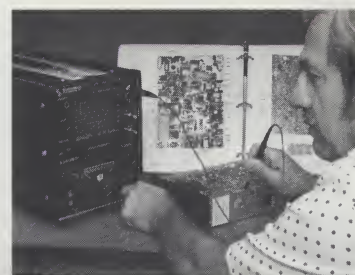
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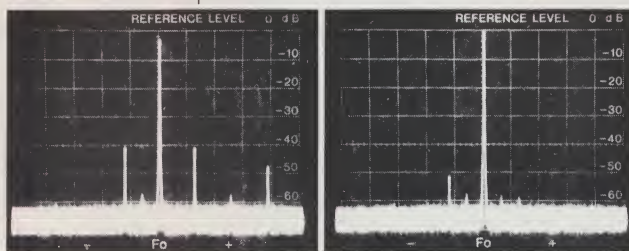
even look for defective components more easily than ever before.

The CE-15's other specialty is making off-the-air measurements for identifying and eliminating interference. It's tunable from 1 to 1000 MHz,

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Before we sell you a two-way FM radio, we subject it to nine separate quality control checks. Nobody tests and inspects more thoroughly. In fact, when a Johnson radio leaves our factory, we're so sure of its quality that we offer a full one-year parts and labor warranty.

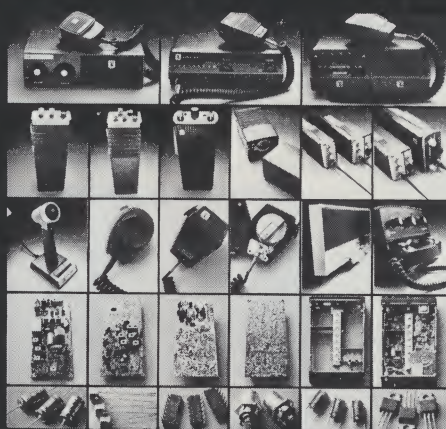
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Harris Corp. RF Communications Division has been awarded a \$1.2 million contract by **Pacific Northwest Bell Telephone Company**, headquartered in Seattle, Washington. The contract calls for the manufacture and supervision of a high capacity mobile telephone terminal and base station control units. The terminal will control all mobile telephone systems throughout the states of Oregon and Washington.

Three exclusive distributors have been appointed to cover the Canadian market for **Standard Communications Corp's** land mobile VHF/UHF two-way communications equipment line. **Canada West Communications Corp.**, 913 Laval Crescent, Kamloops, B.C. V2C5P4 (604) 374-0520 will cover British Columbia and Alberta; **National Industrial Sound**, 639 Portage Ave., Winnipeg, Manitoba R3B2G5 (204) 786-6611 will cover Saskatchewan and Manitoba; and **Cardon Import Canada Ltd.**, 95 McNab St. N., Hamilton, Ontario L8N3C8 (416) 527-1040 will cover Ontario and Quebec. Standard's previous distribution arrangement with International Systcoms has been terminated by mutual agreement.

Maxrad, Maximum Radiation Production, has moved to a new location that will provide higher production capability and larger warehouse space. The address is now Maxrad, 9962 W. Bryn Mawr Ave., Rosemont, Ill. 60018. (312) 671-7400.

ABC-TV crews will televise the action at the 1980 Winter Olympics in Lake Placid, N.Y., next February with the help of an **RCA** two-way radio system valued at more than \$125,000. The order includes TAC100 portable hand-held radios, TAC200 mobile radios to be installed in TV trucks, vans and cars, and two special repeater base stations. The equipment will be used later for network news coverage of the 1980 political nominating conventions.

September 1979

Mobile Communications Service, a Los Angeles, Calif., two-way radio sales and service firm, has purchased all of the equipment, inventory, and customer lists of the **General Electric Mobile Radio Department's Los Angeles Service Center**. The firm will have the responsibility of maintaining radio systems operated by the Los Angeles *Times*, Southern California Rapid Transit District, and many other public and private agencies in the four county area around Los Angeles. In addition, Mobile Communications Service has just completed installation of one of the largest private 800 MHz systems in the U.S. for Associated Charter Bus, a division of ARA Services Inc. The equipment includes 735 GE 4-frequency Executive II mobile units, associated control stations, and repeaters. The radios are installed in buses used primarily to transport school children.

Telecomm Systems Inc., of Eugene, Oregon, has acquired the Bend Telephone Answering Service, as part of an overall plan to provide complete radio and telecommunication services for Central Oregon. Plans are now being finalized to centralize all Telecomm System services at a new Bend office. There will be no major operational changes for the answering service and its customers.

Power Communications Co. (PCC) is now responsible for marketing and distributing of Silent Sam mobile teleprinter message scrambler for **RF Applications, Inc.**, Norwalk, Conn. PCC will be responsible for marketing the equipment on a worldwide basis.

Secode Electronics, Inc., of Dallas has announced the acquisition of the product designs, inventory, and backlog of **Applied Micronix** of Torrance, Calif. The product lines consist of two models of tone signaling components used in two-way radio equipment. □

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23

Associations

The annual membership meeting of the **Special Industrial Radio Service Association, Inc. (SIRSA)**, will be held at the Contemporary Hotel, Lake Buena Vista — Orlando area, Florida, on October 10-13. The theme, "A Look into the 80's," will focus

on the major FCC activities that will affect the Special Industrial users. Speakers for an October 11 panel discussion and question and answer period include Belle B. O'Brien, chief of the FCC Consumer Assistance Office; Dick Smith, ass't. chief, En-

forcement Division of the FCC Field Operations Bureau; and representatives from the FCC's Licensing Division, Private Radio Bureau, and Office of Science and Technology.



The 14th Annual Meeting of the **National Association of Business and Educational Radio (NABER)** was held at Hershey, Pennsylvania, on July 10-13. Combined committee meetings concentrated on three broad areas of discussion: an update on issues before the FCC, frequency coordination, and matters relating to the economic aspects of spectrum management. The latter topic was addressed more fully during the FCC workshop after Carlos Roberts, chief of the Private Radio Bureau, spoke on the subject. (See text of speech, page 52.) The Paging/Medical Section's meeting centered around the reduction in the number of frequencies available for healthcare paging as of January 1, 1980, and what effect it would have on business paging. William Prior, president of Aero-tron, addressed the subject of the state of the industry and its future. He particularly stressed the need for "continuing moral and intellectual support for competitive market mechanisms." At the **Professional Mobile Radio Service Section (PMRSS)** seminar held in conjunction with the NABER meeting, one of the main concerns voiced was that good technicians are difficult to find, and, because salaries are not competitive with other industries, they are difficult to keep. The following men were elected to serve three-year terms as directors of NABER: John Linton, Jr., chairman; William Detwiler, secretary; Richard Meyer, ass't. secretary and legal counsel; Webb Engman, treasurer; Wylie Powell; Ernest Farrington, Jr.; Mal Gurian; Leonard S. Kolsky; and Ronald Zimmerman. Pictured above are NABER committee chairmen, l-r: John Black, Spectrum Management, of Radio Systems, Inc., Seattle; Cliff Bade, Regulatory Rules, of Cleveland Mobile Radio, Cleveland; Jay Kitchen, v.p. of NABER (substituting for James C. McAllister, Frequency Coordination); and Leonard S. Kolsky, Technical, of Motorola C&E, Inc., Washington, D.C.

The **Communications Managers Association** elected officers for the 1979-80 CMA year at a recently held meeting in New York. Charles J. Schweis, CIBA-Geigy Corp., president/1st vice president; Richard J. Meyer, Dun & Bradstreet Corp., second vice president; Gus Bender, Travelers Insurance Co., secretary; Angelo J. Cipriano, American Broadcasting Co., treasurer; and directors, Val B. Bala, Johnson & Johnson; Kenneth H. Ringel, Chemical Bank; George E. Fallat, E.I. DuPont de Nemours, & Co.; Chester Bellairs, Jr., American Broadcasting Co.

The **Chicago Industrial Communications Association**, an organization of administrative personnel from midwestern corporations with responsibilities for data, telephone, two-way radio, and other telecommunications functions recently elected officers. They are Robert James, Dar Foods, Inc., president; Erle D. Whitney, Bunker Ramo Corp., vice president; Richard Jenifer, Insurance From CNA, secretary; Phillip Wilken, Motorola, Inc., treasurer; and two directors, John R. Hart, Lutheran General Hospital, and George Gogola, ITOFCA, Inc.

Elected to office during the **RCC's of Pennsylvania's** Fourth Annual Convention are: Denny P. Watson of Mobile Communication Service, Inc., president; Richard Blyler of Lebanon Mobilefone, treasurer; Ted Ehrhardt of Mobilefone of N.E. Penn., vice president; and Steve Seltzer of Modern Communications Corp., secretary.

The following officers were elected during **Utilities Telecommunica-**

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INFO/CARD 89

Associations Meeting Calendar

September 26-29 Telocator, 31st Annual Convention, Fairmont Hotel, San Francisco, Calif. Contact (202) 659-6446.

October 8-9 Professional Mobile Radio Service (PMRSS) seminar, for Fla., Geo., S.C., Tenn., and Ala. at Orlando, Fla. Contact: Meg Gianessi (202) 659-8334.

October 10-11 PMRSS seminar for Tex., Ark., La., and Miss., at Dallas, Tex. Contact: (202) 659-8334.

October 10-13 Special Industrial Radio Service Association (SIRSA), 1979 Annual Membership Meeting, Contemporary Hotel, Lake Buena Vista — Orlando area, Fla. Contact: (703) 528-5115.

October 15-16 ARINC Research Corp. seminar on "The Impact of Changes in the Regulatory and Tariff Environment on System Planning," Los Angeles, Calif. Contact: (301) 224-4000, ext. 423.

October 16-18 Communications Managers Association, Third Annual Conference and Exhibition, Rye Town Hilton, Port Chester, N.Y. Contact: (914) 478-3131.

October 17-18 Antenna Measurement Techniques Association, Atlanta, Ga. Contact: Joe Pape (404) 449-2354.

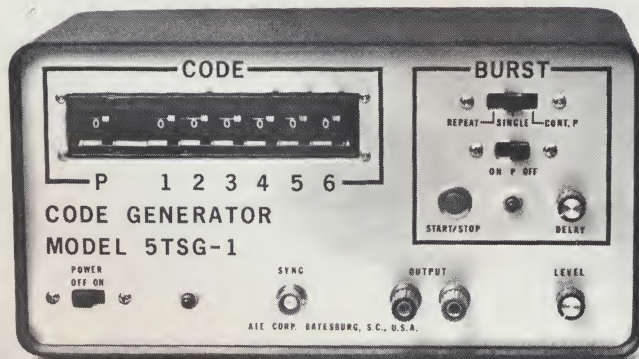
October 31-Nov. 2 Midwestern Telecommunications Conference, Ramada O'Hare Inn, Chicago, Ill.

November 16-20 Communications Marketing Association, CMC-79, Stouffer's Denver Inn, Denver, Colo. Contact: Stan Reubenstein (303) 751-2027 or Jack Daniel (213) 442-0782.

tions Council's (UTC) 31st annual meeting held in Atlanta June 25-28: Earl Rapp of Mountain Fuel Supply Co., president; Warren Chigoy of the New Orleans Public Services, Inc., vice president; and John Abbott of the Los Angeles Department of Water and Power, secretary-treasurer. The meeting was attended by approximately 600 energy utility telecommunications managers and exhibitors and their families.

The Jeremiah Courtney Law Offices of Washington, D.C., have been retained to represent the **California Mobile Radio Association (CMRA)** before the Federal Communications Commission and the Congress. In making the announcement, Richard G. Somers, president of CMRA, explained that the association — composed of some 40 of the leading radio sales and service agencies in California and a frequent commentator and petitioner in FCC Rule proceedings — had been filing its own comments and position papers before the FCC for several years in an effort to explain and advance the interests of the business radio community in California. □

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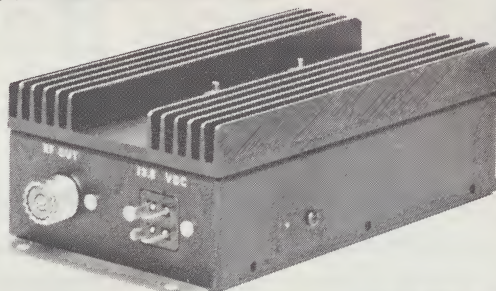
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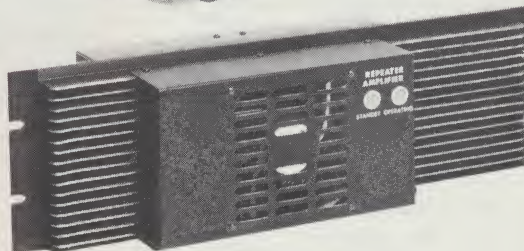
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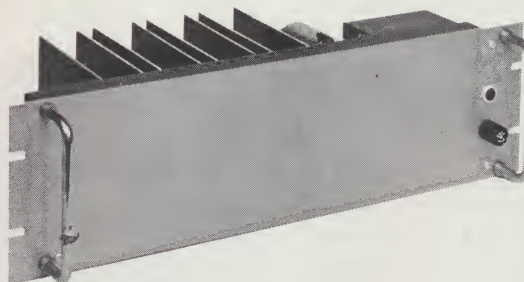


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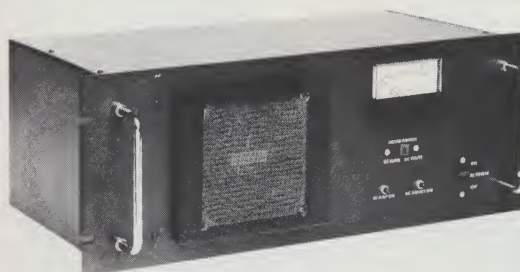


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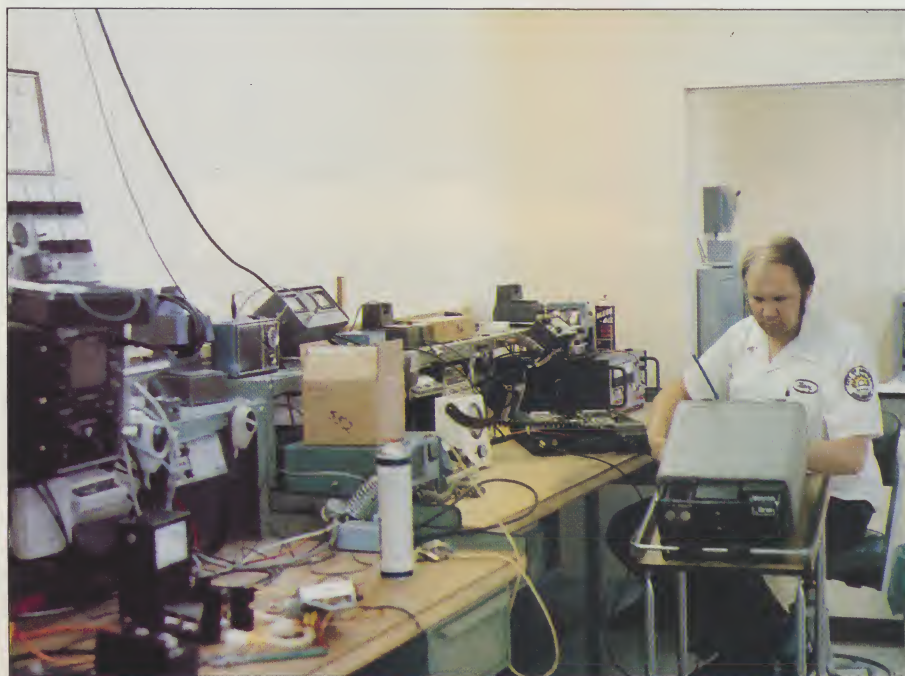
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Setting Up A Service Bench

Planning what one needs and then comparing what the market has to offer before buying test equipment and other tools necessary for a service bench operation is a good way to have a true picture of the time and money involved.

Stan Reubenstein
Aurora Marketing Company



Two types of service benches are represented by (left) Harry Blakeman, electronic specialist for the City of Aurora, Colo., at work in the Aurora City Bench Room and (right) Doug Harmon, chief communications technician for Communications Service Co., a two-way sales and service shop in Englewood, Colo., as he works at one of four benches for mobile radio.

Setting up a two-way service bench is not just planned and budgeted by the entrepreneur who decides to go into business for himself, but it is also considered by companies or governmental agencies that may decide to become what is known as a "self-servicing user."

What two-way technician who works for the "Big Guys," the city service shop, or the local independent hasn't paused while writing a big service order or job ticket and thought about starting his own service shop? Or the radio amateur with a tedious occupation who day dreams about the possibility of working at a vocation that could be integrated with his avocation? Let's not forget the corporate accountant or municipal controller who reviews the service invoices that he must pay. They also contemplate the possibility of setting up their own radio maintenance facilities.

Rather than set up specific guidelines, as individuals and agencies have their own reasons to consider maintaining a service facility, what I shall try to do is outline the specific costs involved in assembling a service bench. A discussion of the tools and instruments required for various levels of maintenance activities, which allows the individual concerned to evaluate his requirements and goals by plug-



Communications

ging in the data that is offered, will follow. Naturally, someone thinking of a service shop for a police department would not have the same equipment or personnel requirements that a large power company might; and by the same reasoning, an independent two-way shop or radio common carrier would not need the same equipment as a shop specializing in oil-field telemetry systems.

However, there is more to running a two-way service shop than just purchasing test equipment. Filing radios, billing customers, and variable and fixed expenses that can be classified as overhead, are all part of the whole picture. But, those are subjects for other articles and will not be dealt with here.

In order for you to organize your thoughts and make a rational determination as to whether or not a service facility is feasible, let's examine some of the primary and secondary instruments that are currently in use by contemporary service shops.

Service Monitor

The communications service monitor is the primary complex test instrument in any well equipped service shop. Modern monitors provide almost every function required to analyze

and/or repair even the most sophisticated mobile radios. The communications service monitor was developed to provide a combination of necessary test equipment in a single instrument. The modern service monitor combines most of the functions of a signal generator, frequency meter, modulation meter, tone generator, oscilloscope, and in some cases, even a watt-meter and spectrum analyzer. The communications service monitor satisfies the majority of test requirements and is mandatory for any well equipped service shop. Considerations for a full function service monitor should go beyond price, because the least expensive monitor (the IFR FM/AM 1000A) has more functions and features than some of its more expensive rivals; however, because we are going to use it, let's examine it with our requirements in mind. Does it have built-in AC/DC power supplies, as well as an internal battery pack? Is it rugged and portable enough to withstand field use? Perhaps this isn't a consideration because you may only use it for bench testing of pocket pagers. Before making a decision, have each of the manufacturers send their representative out to you for a comprehensive demonstration. Then you should make your decision. Price Range: \$7,650 to 13,980.

Spectrum Analyzer

This instrument is no longer a laboratory curiosity, as it has become a useful tool for the radio service shop. With increasing utilization of our limited spectral resources, interference is becoming a significant problem. Areas with low-density populations, especially in the West where two-way radio is relied on heavily to provide basic communications, are also encountering interference due to the multitude of radio signals. Whether the interference problem is due to poorly designed systems, transmitter spurious, or just plain high RF levels, a spectrum analyzer will assist us in evaluating the problem so a specific cure can be initiated.

A common misconception is that the spectrum analyzer is only for interference problems; that is not at all true. A spectrum analyzer is like an oscilloscope, but instead of showing amplitude/time, it displays amplitude/frequency on the vertical/horizontal axes. We can, therefore, utilize this instrument for our day-to-day troubleshooting, in much the same way as we would use a frequency selective voltmeter. We can actually visualize stage-gain and the frequencies involved in each operation of our receivers and transmitters. With oscillators, multipliers, mixers, final amplifiers, anyplace where RF is present, we can use a spectrum analyzer to assist us in our troubleshooting. These instruments are available in packages designed for two-way radio use, as well as the excellent laboratory units produced by many of the major manufacturers of test equipment. Once again, you will have to evaluate each product with your requirements in mind. There are presently two spectrum analyzers, the Texscan AL-51A and the Cushman CE-50, which are intended for the two-way service shop. The Texscan AL-51A is the least expensive of the two and has a lot of features normally found in much more expensive instruments, like crystal controlled markers, the built-in battery pack and even an adjustable noise-squelch. Price Range: \$4,450 and up.

Oscilloscopes

The oscilloscope is another instrument that is not used to its full capacity but can be a primary servicing tool. As stated previously, the oscillo-



scope plots amplitude on its vertical axis and time on its horizontal axis. You can use an oscilloscope to measure and/or compare voltages, frequencies, as well as use it to visually evaluate a voltage, either audio or RF for a number of parameters. The frequency range of a scope is the main limitation to its versatility. Therefore, one of the main factors governing its price is the frequency range. A wide range of available features, limited only by your pocketbook, is offered on oscilloscopes. Some manufacturers

make units with plug-in modules, allowing a quick change of features. There is even a module to convert their oscilloscopes to a full-feature spectrum analyzer. For general service shop use, the scope in general use is the dual-trace 15 MHz type.

These oscilloscopes are available from many manufacturers, through your local parts house. Two manufacturers providing good instruments for low prices are B&K and Leader Instruments. Price Range: \$590 and up.

Tone Encoders

Since it is difficult to include all tone encoding formats within the confines of the basic service monitor, and due to the tremendous increase in tone coding formats, the external tone encoder is widely in use. In addition to CTCSS (continuous tone coded squelch system), there are available DTMF (dual-tone multi-frequency, Touch-tone), digital CTCSS, two-tone sequential, tone-burst, 2805 RCC interrupt, 600/150 MTS, IMTS, 5-tone digital, 5-tone binary, etcetera, etcetera, etcetera. Because of the vast number of tone coding formats, a number of companies have introduced code synthesizers to simulate many encoding modes in conjunction with a signal generator. The most comprehensive introduced to date is the new Motorola R-1100A; however, other instruments are available that will cover one or more encoding modes at lower cost if the extensive capability is not a significant requirement. Price Range: \$387 and up.

Wattmeters

Power output measurements are important when discussing transmitter tests. The two types of wattmeters in general use are the in-line and terminated. The inline wattmeter measures RF output when it is placed in the feed-line between the transmitter and the load. The load may be a resistive type dummy load that will absorb the power and not radiate it, or it could be the actual transmitting antenna. The inline wattmeter normally has a means of displaying both forward and reflected power, and it may be calibrated in watts or SWR (standing wave ratio). The terminated type of wattmeter has an integral dummy load, and it has a built-in meter (either on the load chassis or remotely mounted) for wattage readings. It is a general practice to have an inline type for field measurements (output power and SWR) and a terminated type for bench use. The most widely accepted in-line wattmeter is manufactured by Bird Electronics. Their model 43 has been in use for many years. The meter uses brass elements, or slugs as they are popularly called, to determine the frequency and power range of the instrument. The basic operating instrument would consist of a wattmeter and one element. More elements can be pur-

Communications

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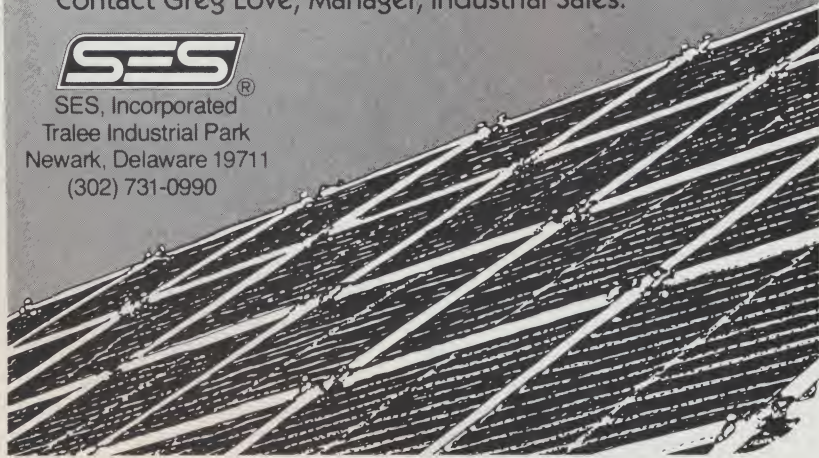
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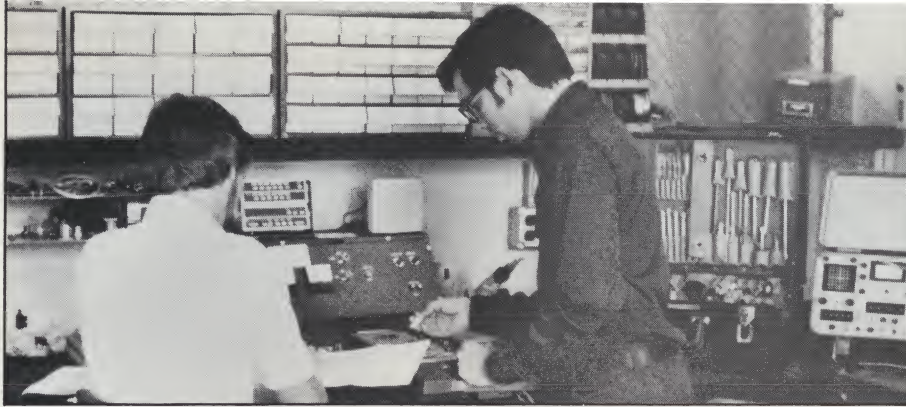
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Jim Pannell, senior SCADA and senior telecom technician (left) and Larry Gallegos, telecom technician II, of Tri-State G&T, a cooperative utility of Thornton, Colo., work at a service bench for a three-state microwave communications system.

chased later to increase the capabilities of the instrument. Price Range: \$125 and up.

SINAD Meter

The Sinadder is a specialized distortion meter for making SINAD measurements on radio receivers. Before Helper Instruments introduced the Sinadder, the SINAD method of receiver measurement was not generally used in service shops due to the complexity of the test procedure. The SINAD measurements of receiver sensitivity is more reliable than the misleading 20 dB quieting measurement that only tells you the CW sensitivity. SINAD sensitivity measurements give you the best sensitivity figure related to minimum distortion. Helper Instruments is still the only manufacturer of the separate SINAD meter. They have two models, the original Sinadder 1 and the new Sinadder 3 with a built-in AC voltmeter and 1 kHz tone generator. Price Range: \$162.50 to 249.

Multimeter

Next in importance to a screwdriver is probably the multimeter. Multimeters come in all shapes and sizes; they are analog and digital, big and little, expensive and inexpensive. But they all do essentially the same thing: they measure resistance. Commonly called the VOM because it measures volts-ohms-milliamperes, the multimeter is an indispensable tool. The most popular ones are those manufactured by Simpson; however, individual tastes dictate the one that is finally selected. The cost is dictated by the number of ranges and their accuracy. An accuracy of five percent

or better is recommended for communications use, although less expensive 10 percent accuracy meters are all right for indication and tune-up use. The analog type scale (meter with needle) is preferred over the digital read-out as it is easier to use for stage-by-stage tuning. Price Range: \$50 and up.

Frequency Counter

The frequency counter was once a laboratory luxury with flashing lights, zillions of vacuum tubes, and clicking relays; now with the advent of solid-state technology, there are even some that will fit in your pocket, calculator style. The frequency counter does exactly what its name implies: it counts frequency. It is not a frequency selective device unless it is coupled with some kind of filtering or tuning mechanism prior to the input. It will display the strongest RF frequency it is seeing on its input with a digital readout on the front panel. The price of the frequency counter is determined by a number of factors, primarily frequency range and accuracy. The higher the frequency range and the better the accuracy — the higher the price. A number of companies are making inexpensive frequency counters that cover a wide range of frequencies. In addition, many companies also manufacture accessories for frequency counters like the Helper Toner, which upscales the frequency to allow quick readout of CTCSS frequencies on inexpensive counters. Price Range: \$195 and up.

RF Voltmeter

RF Voltmeters are really high frequency AC voltmeters that allow radio frequency readings. There are two types of RF voltmeters available:

THE PROLINE SERIES:



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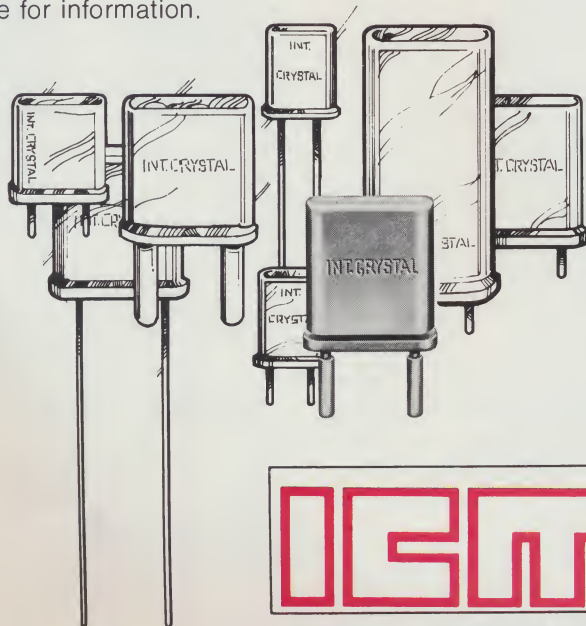
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INFO/CARD 22

those that are frequency selective and those that are not. While the frequency selective voltmeter is certainly handy, the cost factor of 10X or more of the cost of one that is not frequency selective often deters prospective buyers. The RF voltmeter allows you to make voltage measurements in an RF circuit without seriously affecting the operation of that circuit through the use of specially designed high-impedance RF probes. One disadvantage of RF voltmeters that are not frequency selective is that the accuracy usually suffers slightly at higher frequencies (above 1 GHz). Because our primary concern is for lower frequency (below 1 GHz) use, the minor trade-offs certainly compensate for the lower price. The RF voltmeter has begun to have widespread acceptance as an integral part of the two-way service shop since the introduction of the Helper Instruments RF-801 that sells for less than \$600. The two-way technician now has an inexpensive method of doing stage-gain measurements. Price Range: \$590 and up.

DC Power Source

A power source for simulating mobile or portable DC supplies is a necessity. Due to the high current demands of some transceivers, a hefty supply providing upwards of 20 amps is usually required. Hand-held transceivers and pocket pagers, with a much lower current demand and delicate circuitry, require low current, variable voltage, current limiting power supplies. Most modern solid-state radios require a moderate current (less than 5 amps RX or SBY) and high current (10 to 30 amps) on transmit. One popular power supply is the Lapp Model CR-40, as it has variable voltage from 1 to 40 volts and intermittent current outputs up to 50 amps. Now that sophisticated battery chargers are available at low cost, the use of sealed car batteries with automatic battery chargers, like the Newmar ABC 12-15, has become a viable alternative. (Remember that if batteries are used they should be adequately vented to the outside.) Price Range: \$169 and up.

Desoldering Tools

With the advent of printed circuit boards and various types of solid state components (especially integrated circuits), the ability to remove and

Communications

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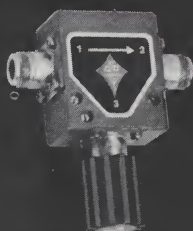
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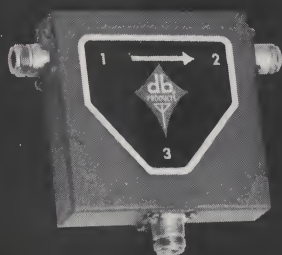
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- Prompt Delivery
- Patent Applied

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replace parts without damaging them, the circuit board, or associated components is extremely important. Various manufacturers who recognize this problem have come up with a number of specialized tools. These range from a desoldering bulb integrated onto a soldering iron to a whole range of pressure or vacuum operated devices. One new item that is completely self contained is the Pace PC-10 at \$325. This unit has its own self contained vacuum source and adjustable temperature settings for its desoldering tip. Price Range: \$25 and up.

Miscellaneous

Besides all of the items mentioned above, there are a number of essential parts and pieces that you will still require before you can even begin to operate your service bench. First of

all, you will need a test bench. There are a number of test benches that are commercially available that are already set up with the required lighting and outlets. Many shops prefer to build their own. Tools, spare parts, and test sets for radios that will be repaired considerably are also required. The costs of test sets vary from manufacturer to manufacturer and will have to be determined from their catalogues. Tools are a matter of personal taste, but the basics are diagonal cutters, a screwdriver set (both slotted and phillips), a nut-driver set, adjustable end wrench, socket set, electric drill, and bits. In addition, spare electrical parts, wire, and other hardware is required to make your bench usable.

The suggested equipment list (See Example 1.) is not intended as a shop-

Item	Make & Model	Cost
Communications Service Monitor	IFR FM/AM 1000S	\$ 9,450
Spectrum Analyzer	Texscan AI-51A	4,450
In-Line Wattmeter	Bird Model 43	125
	Elements (5 @ \$38 ea.)	190
Wattmeter/Dummy Load	Bird Model 6154	295
RF Voltmeter	Helper RF-801	590
SINAD Meter	Helper S-103 (Sinadder 3)	249
Frequency Counter	DSI C-700	370
Dual-Trace Oscilloscope	B&K 1472	840
Code Synthesizer	Motorola R-1100A	595
Multi-Meter	Simpson 260-6	95
DC Power Source	Lapp CR-40	468
Desoldering Station	Pace PC-10	325
Asst. Tools, Bench, Lighting, Test Sets, Spare Parts, etc.		2,000
Approximate Cost		\$20,042

Prices are f.o.b. factory based on current literature and pricing information that was available to the author.

Example 1. Suggested Equipment List for a Two-Way Radio Service Shop.

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6AK6	1.44	6BU8	1.95	6HQ5	2.00	12BE6	1.27
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6AN8A	1.83	6CB6A	1.30	6KD6	3.35	12JB6	2.50
6AQ5A	1.33	6CG8A	1.70	6KZ8	1.62	12SN7GT	1.75
6AQ6	1.42	6CJ3	1.48	6L6GC	2.42	20LF6	3.25
6AT6	.87	6CL6	1.94	6LB6	3.20	35W4	1.00
6AU4GTA	1.84	6CL8A	1.93	6LF6	3.17	50C5	1.20
6AU5GT	2.27	6CM6	1.68	6MJ6/6LQ6/ 6JE6	3.50	5879	2.45
6AU6	1.28	6CM8	1.55	6SJ7	3.75	6267	1.40
6AU8A	2.00	6CS7	1.57	6SL7GT	2.15	6973	1.95
6AW8A	1.75	6CX8	2.22	6SN7GT	2.15	7027	2.95
6AX5GT	1.85	6DC6	1.33	6T8	1.80	7189	1.65
6BA6	1.33	6DE7	1.75	6U8	1.55	7199	2.05
6BC4	3.10	6DK6	1.37	6V6GT	1.82	7868	2.17
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2C39WA	26.00	6550A	5.25	8348	37.50
2D21	1.40	6660/6BA6	1.20	8458	17.95
2E24	5.75	6661/6BH6	1.25	8462	95.00
2E26	4.50	6662/6BJ6	1.30	8505A	55.00
3B28	6.75	6663/6AL5	1.15	8509	68.50
3CX400U7/ /97-10794AO1	175.00	6664/6AB4	1.20	8552/6883B	4.90
3WPI	18.00	6669/6AQ5A	1.20	8560/AS/ AO1/AO2(PQ)	46.50
4CX250B	31.00	6676/6CB6A	1.10	8595	12.50
4-125A/4D21	42.00	6677/6CL6	1.85	8624	51.00
5DEP1	18.00	6678/6U8A	1.50	8643(PQ)	59.75
5R4GB	2.25	6679/12AT7	1.25	8737/5894B	42.00
6DJ8	1.85	6680/12AU7	1.15	8753	35.00
7C5	2.50	6681/12AX7	1.15	8908	4.75
7F7	10.50	6883B68032A	4.90	8950	3.75
7N7	10.50	6907	49.00		
7V7	3.75	6939	11.50		
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G1501	12	INT	19.38	11.63	8.25	G1501
1513	6/12	INT	20.42	12.25	8.70	1513
G1532	12	INT	15.53	9.32	6.70	G1532
1601	6	INT	13.42	8.05	5.60	1601
G1601	12	INT	13.55	8.13	5.75	G1601
G1602	12	INT	12.78	7.67	5.50	G1602
1701A*	6/12	INT	25.25	15.15	10.50	1701A*
1701A* Bulk Pack Min. order 25					9.50	1701A*
1751	6	INT	25.61	15.37	10.75	1751
G1801	12	SYN	18.47	11.08	8.00	G1801
1806	6	SYN	22.28	13.37	9.60	1806
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ASSR-1002	OZ4, 5X4, 5Y4, 6AX5 5852, 5839	F.W.C.T.	1600	750 Ma.	3.50
ASSR-1003	5AV4, 5AW4, 5AZ4, 5T4, 5U4, 5V4, 5W4, 5Y4, 5Z4, 5AX4, 5AV4, 5931, 6004, 6087, 6106.	F.W.C.T.	1600	750 Ma.	3.50
ASSR-1004	5AU4, 5AW4, 5U4, 5W4, 5Y3	F.W.C.T.	1600	600 Ma.	3.50
ASSR-1005	3B24, 3B24W		20,000	.075 A.	25.00
ASSR-1006	5R4GY, 5R4W	F.W.C.T.	2800	500 Ma.	5.50
ASSR-1007	6AV4, 6AX4	F.W.C.T.	4500	.25 A.	5.25
ASSR-1008	6X4, 12X4, 6032	F.W.C.T.	1600	500 Ma.	4.25
ASSR-1009	6Z4, 84	F.W.C.T.	1500	.085 A.	4.25
ASSR-1010	575A	H.W.	15,000	1.5 A.	35.00
ASSR-1011	673	H.W.	15,000	1.75 A.	41.00
ASSR-1012	816, 836,	H.W.	7000	300 Ma.	8.50
ASSR-1013	866A, 866AX, 3B28	H.W.	10,000	500 Ma.	7.00
ASSR-1014	872A, 872AX, 4B32	H.W.	10,000	1.25 A.	25.50
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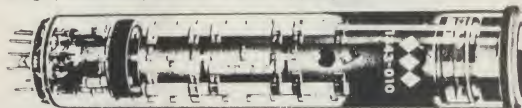
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2N6084	40 Watt 175 MHZ 12V Stud	12.75	2N3773		2.95
2N6136	25 Watt 450 MHZ 12V Stud	16.00	2N5193		.80
GE no. 4	50 Watt PNP Germanium Power Amplifier	4.25	2N5589	4 Watt 175 MHZ 12V Stud	3.75
568 BLYC(F)	80-100 Watt 50 MHZ 12V Stud or (Flange)	16.95	2N5590	12 Watt 175 MHZ 12V Stud	5.05
SD 1089	40 Watt 450 MHZ 12V 6 lead Flange	19.50	2N5591	25 Watt 175 MHZ 12V Stud	7.50
SD1416	70 Watt 175 MHZ 12V 6 lead Flange	19.50	2N5641	7 Watt 175 MHZ 28V Stud	4.05
BLY 87CF	4W (Linear to VHF 12V Flange)	5.25	2N5642	20 Watt 175 MHZ 28V Stud	7.50
BLY 89CF	25-30W (Linear to VHF 12V Flange)	9.00	2N5643	40 Watt 175 MHZ 28V Stud	11.75
BLW 60CF (3)	40W (Linear to VHF 12V Flange)	11.00	2N5691	40 Watt 50 MHZ 12V Flange	12.95
SD 1256	PT 3503	4.10	2N5847	8 Watt 50 MHZ 12V Stud	6.35
			2N5848	20 Watt 50 MHZ 12V Stud	9.50
			2N5849	40 Watt 50 MHZ 12 V Stud	13.35
			2N5944	PT 4150A 2 Watt 450 MHZ 12V Stud	5.75
			2N5945	PT 4150B 4 Watt 450 MHZ 12V Stud	9.25

NOTES

1. Not all available cross references and types listed. Please call.
2. Check throughout pamphlet for types that meet your needs.
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MRF454A = 568BLYC = RF95
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5	DRN5/2N3638A	.21
6	DRN 6	1.10
1 AMP 1000 PIV DIODE (1N4007)		1-99 .13 100 .09
1½ AMP 1000 PIV DIODE (1N5399)		.37
2½ AMP 1000 PIV DIODE (R170)		.23
SPECIAL: 1 AMP 1250 PIV DIODE (BY 127)		1-99 .34 100 .30

Motorola No.	Our No.	Price	Motorola No.	Our No.	Price
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48-124331	2N1542	1.55	M 9627	2N3232	1.05
4606	2N1542	1.55	M 9628	2N3772	1.90
48-82466H13	1N4003	.08	M 9631	2N4427	1.10
48-82466H18	1N4007 (see above)	.13	M 9638	MPS3646	.50
48-84755H01	2N5061	.45	M 9639	2NS771	1.85
M 9130	2N1309	1.85	M 9640	MPSU01	.80
M 9135	2N1560	2.50	M 9641	MPSU51	.80
M 9197	2N2712	.20	M 9642	MPSA20	.50
M9252	2N2716	.28	M 9643	MPSA70	.55
M9256	2N2646	.80	M 9645	TIP41C	.75
M 9301	2N3054	.70	M 9648	DRN11	.30
M 9302	2N3055	.85	M 9649	TIS93	.35
M 9316	2N3927	6.30	M 9651	2N5485	.60
M 9328	2N4403	.40	M 9652	2N5486	.60
M 9477	2N3926	4.50	M 9654	SD1080	1.15
M 9494	MPS6507	.70	M 9657	2N4427	1.10
M 9528	MPS6520	.45	M 9660	2N5461	.50
M 9543	MPS6543	.89	M 9662	MPS6548	.52
M 9548	2N5086	.45	M 9663	MPS6568A	.60
M 9563	MPS2714	.32	M 9665	2N5691	11.50
M 9568	MPS6532	.34	M 9675	2N930A	.70
M 9570	MPS3711	.22	M 9676	TIP41C	.80
M 9571	MPS3703	.22	M 9677	DRN10	1.05
M 9572	MPS6566	.28	M 9687	3N201	.88
M 9580	2N6081	6.25	M 9703	2N4427	1.10
M 9583	2N6083	9.00	M 9718	5944	5.75
M 9584	2N5635	5.25	M 9719	5945	9.25
M 9585	2N5636	9.50	M 9720	5946	10.95
M 9586	2N5637	11.95	M 9728	2N5913	1.90
M 9587	2N6081	6.25	M 9740	SD1088	17.50
M 9588	2N5589	3.75	M 9741	SD1088	17.50
M 9591	2N4427	1.10	M9780	2N6080	4.25
M 9594	2N5088	.45	M 9806	TIP41C	.75
M 9599	2N5913	1.90	M9807	DRN10	1.05
M 9614	2N1167A	4.20	M 9850	SD1429	9.50
M 9616	2N5637	11.95	M 9851	SD1088	17.50
M 9618	MJE371	1.20	M 9859	SD 1127	2.45
M 9619	MJE521	1.05	M 9860	SD1143	6.25
M 9622	2N6094	4.30	M 9867	2N4427	1.10
M 9623	2N6095	6.50	M 9874	SD1088	17.50
M 9624	2N6096	8.25	48-870405	IN23C	1.25
M 9625	2N6097	12.50			

GENERAL ELECTRIC

GE No.	Our No.	Price
19A115100P1	1N458	.30
19A115123P1	2N2712	.20
19A115247P1	2N1024	1.45
19A115249P1	2N918	.45
19A115293P2	2N1537	2.50
19A115300P1	2N3053	.35
19A115330P1	2N4274	.28
19A115342P1	2N918	.45
19A115362P1	2N2925	.23
19A115413P1	2N2996	2.10
19A115527P1	40250	1.05
19A115552P1	2N2714	.35
19A115706P1	2N3638A	.21
19A115768P1	2N3702	.28
19A115774P1	40251	1.45
19A115839P3	2N5849	13.25
19A115910P1	2N3904	.30
19A116029P3	2N6136	16.00
19A116191P1	SD1236	13.00
19A116203P1	TIP33B	1.15
19A116742P1	2N5496	.80

RCA

RCA No.	Our No.	Price
247774	2N5849	13.25
247994	2N4427	1.10
247997	2N6082	8.05
249711	2N4398	1.85
249688	2N5849	13.25
249689	2N5849	13.25
421025	2N6082	8.05
422901	2N6136	16.00

JOHNSON

Johnson No.	Our No.	Price
576004-003	2N3926	4.50
576004-005	SD1077	1.45
576004-015	2N5847	6.75
576004-017	2N5691	11.50
576004-018	2N6082	8.05
576004-024	SD1089	19.50

AEROTRON

Our No.	Use/Cross Ref.	Price
2N3646		.25
2N5223		.16
2N5225		.17
2N5226		.22
2N5590	60TT25 Driver	5.75
2N5591	60TT25 Final	7.50
2N5883		2.60
2N5913	12V UHF-2WT039/4811-0000-039	1.90

GE No.	Our No.	Price
19A116774P1	2N5210	.40
19A116818P1	3N187	2.75
19A129181P1	2N5590	5.05
19A129181P3	2N6083	9.00
19A129181P4	2N6084	12.50
19A134060P1	2N5590	5.05
19A134060P3	2N6082	8.05
19A134093P1	2N4391	1.10
19A134104P1	2N5849	13.25
19A134239P1	SD1088	17.50
19A134239P2	SD1088	17.50
19A134242P1	CM45-12	20.50
19A134243P1	CM45-12	20.50
19A134340P1	BLY89CF	9.50
19B200131P1	2N502	1.50
19C300037P4	2N502	1.50
4037839P1	2N1510	1.70
4037993P1	2N1303	1.40
5490810P1	2N442	1.40
5492655P4	2N1086	.60
5496663P3	2N178	.95

RCA No.	Our No.	Price
423924	SD1089	19.50
423925	SD1088	17.50
430412	SD1416	19.50
430414	SD1427	14.50
434245	SD1416	19.50
434416	SD1089	19.50
437006	2N6136	16.00

Johnson No.	Our No.	Price
576004-027	SD1089	19.50
576004-028	SD1089	1.20
576004-051	SD1143	6.25
576004-053	SD1416	19.50
576004-057	2N5946	10.50
576004-058	2N3553	.95

Our No.	Use/Cross Ref.	Price
2N5986		2.28
2N6080	Impact 6 Driver	4.25
2N6081	4811-0000-011	6.25
2N6084	Impact 6 Final, 4821-0644-012	12.50
RF75	CD2188/A60-12 for 70TT 50	15.25
SD1133	4821-0000-027	5.95
SD1229	4821-0000-024	8.95
SD1416	4811-0000-045	19.50

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ping list for you to use in stocking your test bench, but it is a result of a discussion with a local police communications officer. He wanted to assemble a list of necessary test equipment, tools, and other items that he could present to the city council as a budget for equipping a city service shop. He felt that he could get an allocation of approximately \$20,000 and he wanted to see if he could put together a first-class test bench in that price range. The resulting list is a compilation of popular test equipment that is currently available, based on an informal survey of two-way service shops. The items suggested are not always the least expensive nor the most expensive, but they are items that are a good dollar value or the accepted industry standard. It should be a good general guideline to use in selecting a serviceable work area. Each technician maintains his own preferences with respect to specific bench items, and the final selection is an involved process that may take many months.

Equipment Sources

Your best sources for test equipment are each manufacturer's local or area representative. Contact the manufacturer for his name; he not only can assist you in determining whether his product is right for you, but he can also assist you in locating items he doesn't carry. The used and surplus market should not be avoided, as many good deals are available with

About the Author

After several years of experience with local sales and service organizations, Stan Reubenstein became sales manager on a national basis for Standard Communications and TPL Communications. In 1977, he established Aurora Marketing Company, a manufacturers' representative organization for the Rocky Mountain states. He is the 1979 national conference chairman for Communications Marketing Association.

a little bit of detective work. Your local electronic distributor should have many of the common parts and hardware items, and he will be willing to stock many specialized items if you can demonstrate an ongoing requirement.

When selecting your equipment keep an open mind. Just because your best friend or previous employer always used Brand X it does not necessarily mean that it is still your best value or the most versatile product of its type. Avoid new brands or models until you are sure that it will provide you the service you require. Be sure that you thoroughly examine all warranties carefully. A three year warranty may not give you as much protection as one that is 90 days parts and labor.

Selecting test equipment can really be a lot of fun. Just try to maintain your objectivity, and you shouldn't run into too many problems. □

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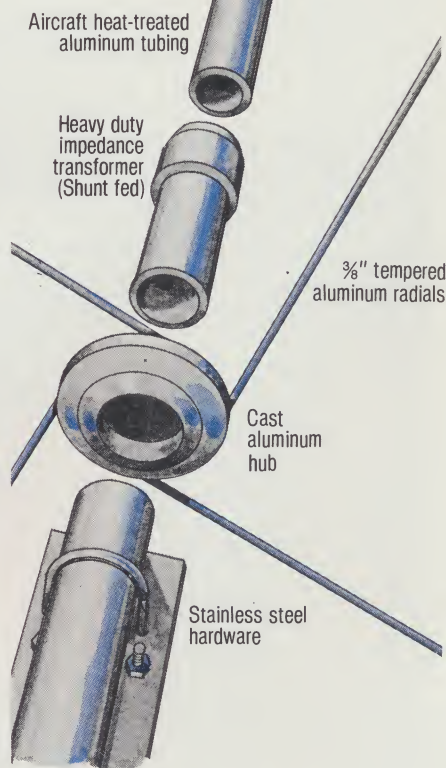
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INFO/CARD 28

This first installment deals primarily with the FCC (supplemental) Form 400-S, which is reproduced within this article. Future segments will deal with the FCC's recently announced "Single Call Sign — Single Application" program, with emphasis on the SMR (Specialized Mobile Radio System) user licensee and the more intricate filings required for trunked systems.

Helpful Hints on 800 MHz

F. Stuart Meyer
Mgr., Government & Industry Relations
E.F. Johnson Company

Glossary

AAT	Above Average Terrain
CRO	Community Repeater Operator
ERP	Effective Radiated Power = transmitter power output minus transmission line (and other coupling device) loss, plus/minus antenna gain or loss.
IRAC	Interdepartmental Radio Advisory Committee. This is a Federal Government activity that plays the role of the FCC but relates to Federal Government frequency allocations including land mobile.
RCC	Radio Common Carrier
SMR	Specialized Mobile Radio System
Trunked	An automatic switching technique that pools a number of frequencies (channels) in a multi-channel system, thus providing all units maximum access (minimum waiting time) to the system.

Note: At 800 MHz, licensees must meet the loading criteria (mobile count) within eight (8) months in order to continue assignment protection for exclusive use of a channel in the related market area. It is FCC policy to send a letter to all licensees (at 800 MHz) questioning their mobile count at the end of this eight (8) month period. Failure to respond to this letter or submission of false information can result in loss of this assignment protection or, in some instances, more drastic action.

Those who file applications directly with the Federal Communications Commission will benefit most from this series of articles explaining the preparation and the submission of license applications in the 800 MHz band. However, those who file through a government liaison office will also find a number of helpful hints and suggestions in the following material.

The articles have been written with the assumption that the reader has some familiarity with the subject of 800 MHz land mobile radio systems. (For background information, please refer to the following editions of *Communications Magazine*: April, July, August, 1977; May, June, November, 1978.)

As a Refresher

Here are a few differences between 800 MHz and the lower frequency bands (as of the writing of this article):

- There are no RCC frequency assignments at 800 MHz.
- Under certain conditions, Public

Communication

Licensing

Safety, Industrial (including Business Radio) and Land Transportation may be intermixed on the same channels.

- There are no Federal Government (IRAC) frequencies at 800.
- There are no single frequency simplex assignments in this band.
- The base station (or mobile relay) is always assigned the *higher* frequency of the pair.
- Paging is not authorized (although it is presently under consideration).

Filling in the Form 400-S

First, look at the sample Basic Information Form that is addressed to the FCC. This form is helpful to them in determining what you are trying to accomplish with the related application(s). If you use a government liaison office, address the form to them as they, too, will find the checkoff list most helpful.

Again, Back to the 400-S

You must submit one (and only one) Form 400-S with each radio

September 1979

BASIC INFORMATION FORM

Date _____

Licensing Division
Private Radio Bureau
Federal Communications Commission
Washington, DC 20554

Attn: Advanced Systems Unit, Room 5308 (2025 "M" Street, NW)

On behalf of _____ is filing an 800 MHz system application(s) representing:

- _____ (a) A (new) Independent User.
- _____ (b) A modification of an existing Independent User License.
- _____ (c) A proposed shared Community Repeater of which this applicant is the first proposed licensee and the Community Repeater Operator (CRO) is: _____
- _____ (d) Add-on to an existing shared Community Repeater and the CRO is: _____
- _____ (e) A modification of a licensee on a shared Community Repeater and the CRO is: _____
- _____ (f) A proposed cost-shared, not-for-profit facility, and the first user is: _____
- _____ (g) An Add-on to a cost-shared, not-for-profit facility and the list of other users appears on the reverse side of this form.
- _____ (h) A (new) SMR Entrepreneur.
- _____ (i) A modification to an existing SMR Entrepreneur License.
- _____ (j) A (new) user of an SMR and the Entrepreneur is: _____ call sign
- _____ (k) A modification of an SMR User Licensee and the SMR Entrepreneur is _____ call sign
- _____ (l) Other: _____

Radio Service _____ File # _____ *

Frequency Pair _____ File Date _____ *

Call Sign(s) of License(s) to be modified _____ *

*If known and/or if applicable to this filing.

If any questions arise regarding the attached filing, please contact:

system application even though your submission might contain more than one base station, mobile relay, control station, etc. In other words, a submission of an application for an

SMR entrepreneur mobile relay facility requires only one 400-S, even though more than one mobile relay application might be submitted.

A submission of an application for

an SMR user requires its own Form 400-S even though you may be submitting it at the same time as a related SMR mobile relay application. If you are both the SMR entrepreneur and the SMR user, treat them as separate systems with their own individual 400-S forms.

Now, let's start with page 1 of 400-S, from the top down.

Do not fill in the File No. section even though you may be modifying an existing license with a file number assigned to it. This space is for FCC action only.

Question 1 should pose no problem.

Question 2, section (a), is to be checked for all non-trunked systems; that is, all single channel and manually switched channels (up to five). The next section of this question can be tricky because a copy of a purchase order is required for all submissions relating to ten or more mobile units. The total number of units in the second part of (a) should agree with the Form 400 (or Form 425). If the first part of this section refers to less than ten units but the next part references ten or more mobiles, a copy of a purchase order is mandatory. This may be in the form of a delivery schedule contract.

Note: The techniques of entering a mobile count of less than ten after the "time of grant" section of 2 (b) and a mobile count of ten or more in the "eight (8) months" section will require a copy of the purchase order. *Do not* fill in section 2 (b) for an SMR entrepreneur application.

With respect to the "trunked systems" section designated (b), it is suggested that you contact your equipment supplier at this time as this subject is beyond the scope of this installment.

Look at Question 3 Carefully

Section (a) is to be checked for private systems, SMR users, and those operating through a community repeater. Remember that a community repeater is a collection of individual private system licensees who have made an arrangement with a supplier. Looking at this section another way, if you checked (a), (b), (c), (d), (e), (j), or (k) on the Basic Information Form, then check 3 (a) on the 400-S.

Section 3 (b) is for the truly cost-shared, not-for-profit facility (base or mobile relay), and you

FCC Form 400-S
June 1975

Form Approved
GAO No. B-180227 (R0185)

United States of America
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

SUPPLEMENTAL INFORMATION FOR
TRUNKED AND CONVENTIONAL SYSTEMS
(806-821 MHz and 851-866 MHz Bands)

File No. _____

The following supplemental information is required when making application for Trunked or Conventional Systems of Communication to operate in the 806-821 MHz and 851-866 MHz frequency bands in accordance with the provisions of Subpart S of Part 89 of the Commission's Rules. For details as to the data to be furnished, refer to the instructions for each item.

1. NAME OF APPLICANT (as given on FCC Form 400 or FCC Form 425):

2. Application is being made for (check one and complete where necessary):

(a) a conventional system ☐

State the number of vehicular _____ and portable units _____ the applicant expects to place in operation at the time of grant.

State the number of vehicular _____ and portable units _____ the applicant expects to be in operation within eight (8) months from the date of grant.

(b) a trunked system ☐

State the number of mobile units (vehicular and portable) the applicant expects to place in operation within the term of the license period or within two (2) years from the date of the grant, where appropriate: _____ See instructions.

3. The facilities requested will be employed to provide service (check one and complete where necessary):

(a) to the applicant ☐

(b) to eligibles under Parts 89, 91, or 93 on a cost-shared, not-for-profit basis. Furnish, as Exhibit No. 1, a copy of the agreement under which service will be offered. Include, also, a statement of the purpose for which the proposed system will be used; give the name and address of each person to participate in the arrangement; and show that each participant named is eligible to use the system (for the purpose for which it is to be employed). ☐

(c) to eligibles under Parts 89, 91, or 93 on a commercial basis ☐

Furnish, as Exhibit No. 2, a copy of the contract under which base station facilities are to be offered. Include, also, a statement of the purposes for which the system will be used and, in addition, a certification that no person not fully qualified or eligible to employ the radio facilities, under the controlling rules and regulations of the Commission, will be provided service.

(d) If the application is for a mobile, control station, or a control point to be associated with a base station facility referenced at Item (c), give the name of the licensee of the base station facility and call sign(s) of the station(s). ☐

Name of licensee:

Call sign(s) of station(s):

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INFO/CARD 29

Larsen Antennas

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should read the instructions carefully at the top of the second page. 3 (b) is checked when (f) or (g) are checked on the Basic Information Form.

Continuing, 3 (c) is to be checked if you did so on (h) or (i) of the Basic Information Form. This pertains to SMR entrepreneur applications only.

Section 3 (d) pertains to the SMR user and should be checked, in addition to 3 (a), if you checked (h) or (i) on the Basic Information Form. This should be followed with the name of the SMR entrepreneur. If his application is pending, so state by indicating the date of filing and file number (if known); otherwise, enter his mobile relay call sign(s).

For most of you, question 4 will be checked "no."

Now, let's look at 5 (a), which pertains only to 800 MHz systems. The list should show those that are within the same market area and those that are not, unless you are able to check off the "no" box.

Moving to the third page of this form, we will not discuss 5 (b) for the previous reasons given under "trunked systems."

Question 6 will be answered in most cases by checking (a) as this is the most popular mode of operation at 800 MHz although some systems are licensed as indicated in (b). Both (a) and (b) also pertain to SMR users as appropriate.

Discussion of sections (c) and (d) will

4. Is the applicant engaged in the manufacture of radio frequency (RF) equipment employed in land mobile systems of radio communications?

If "Yes," is the applicant, or any person or entity directly or indirectly controlled by the applicant or who directly or indirectly controls the applicant, authorized to operate any other trunked facility?

Yes No

5. (a) Is the applicant, or any other person or entity directly or indirectly controlled by the applicant, or who directly or indirectly controls the applicant, authorized to operate any conventional radio system?

If "Yes," furnish as Exhibit No. 3 a list of all such conventional stations whose base station transmitter sites are within forty (40) miles of the location of the base station transmitter site of the proposed facility.

(b) Is the applicant, or any other person or entity directly or indirectly controlled by the applicant, or who directly or indirectly controls the applicant, authorized to operate any trunked radio system?

If "Yes," furnish as Exhibit No. 4 a list of all such trunked stations whose base station transmitter site is within forty (40) miles of the location of the base station transmitter site of the proposed facility.

Yes No

6. The radio system will be operated (check one):

(a) As a mobile relay facility. ☐

(b) In two-frequency simplex mode. ☐

(c) In full duplex mode. ☐

(d) Other. (Furnish as Exhibit No. 5 a statement describing the manner in which the facility, if authorized, will be operated.) ☐

be deferred to a later part of this series when trunked systems are dealt with.

Question 7 must be answered when a base station or mobile relay station is a part of the filing. *It is not*

7. The height of the antenna (above average terrain) of the base station is:

_____ feet _____

8. The effective radiated power of the base station is:

_____ watts _____

9. Furnish, as Exhibit No. 6, the following information:

(a) A functional diagram of the planned radio system. Include with this, a block diagram showing the location of the antenna site in relation to the control station or control point and the area in which applicant's mobile units will operate. Give distances in miles between the control point or control station and the base station facility and indicate, in miles, the point most distant from the site of the antenna and that at which applicant's mobile units are to operate.

(b) The method(s) of signalling to be employed in the system of communication proposed.

Applicants furnishing this information need not submit the functional system data requested on FCC Form 400, Item (13) and FCC Form 425, Item (16).

answered on SMR User applications because they are not licensed for the base station facility, and this information is not required for any control stations. Where more than one base/mobile relay station is submitted, it is permissible to make multiple references with the proper designations. AAT information is available from NABER for those cities that are currently authorized to operate in the 470-512 MHz band. [AAT may be calculated as described in Section 89.123(b), Table A, antenna height in feet (AAT), note 1 as set forth under Subpart A of Part 89 of the FCC Rules.] It is not necessary to submit the calculations with the application although it is a good idea to keep them in your files in case the FCC questions you.

In answering question 8, be sure to use ERP and once again, if multiple stations are involved, it is permissible to make multiple references rather than submit additional Form 400-S's.

Question 9 can be answered by using the simple system diagrams that the industry has been using for

Communications

many years. In most instances, (b) of this question will be answered as "Continuous Tone Squelch."

On the last page of Form 400-S, 10 (a) is the usual minimum power required rule for control stations and, of course, should be answered as "yes." If no control station is involved, type in "dna." 10 (b) (1) and 10 (b) (2) apply only to trunked systems which are not covered in this presentation. In all conventional applications, fill in "dna" or leave blank. Section (c) of question 10 will normally be checked as "yes."

And most important, be sure that the information at the bottom of this page is properly filled in, agrees with the related application(s), and is signed by the applicant.

I trust that the foregoing information has cleared up some of the problems that you may have had with the 400-S form. As mentioned pre-

About the Author

F. Stuart Meyer is manager, Government & Industry Relations, for the E.F. Johnson Company. He has held positions with Link Radio Corporation, Allen B. DuMont Laboratories, the Hammarlund Manufacturing Company, Aero-tron, Inc., and the RCA Corporation. "Stu" is vice president of the Vehicular Technology Society of IEEE, chairman of the Communications Division Engineering Panel of EIA, a director of NABER, the executive vice president of the Radio Club of America, and is active in many other land mobile organizations.

viously, follow-up articles will go into more detail as well as cover pending rule and policy changes now under consideration at the FCC. ☐

10. (a) Where control station(s) are to be used in the proposed system of communication, will the output power of the proposed control station transmitter(s) be adjusted to comply with the requirements of Section 89.652 of Subpart S of Part 89 of the Commission's Rules.

(b)(1) Does the applicant certify that, pursuant to the provisions of Section 89.801(c) of Subpart S of Part 89 of the Commission's Rules, a minimum of 70 percent of the mobiles specified in the application will be placed in operation not later than the date on which the term of the license for the facility is to expire.

(b)(2) Does the applicant certify, where he elects to construct in five-channel stages, that 70 percent of the required mobile units for loading for five channels will be placed in operation within two (2) years from the date of grant.

(c) Does the applicant certify that, pursuant to the provisions of Section 89.802(c) of Subpart S of Part 89 of the Commission's Rules, a minimum of 70 percent of the mobiles specified in the application will be placed in operation not later than eight(8) months from the date of the grant of the license for the requested system.

Yes No

The applicant acknowledges that, where the authorized facilities are not fully (actually) loaded in accordance with the applicable loading requirements set out in Sections 89.801 and 89.802 of Subpart S of Part 89 of the Commission's Rules, any channels not so occupied may be assigned, at the discretion of the Commission, to another applicant in accordance with the policies set out under this Subpart S of Part 89 of the Rules.

WILLFUL FALSE STATEMENTS MADE ON THIS APPLICATION ARE PUNISHABLE BY FINE AND IMPRISONMENT. (U.S. CODE, TITLE 18, SECTION 1001)

NAME (Type or print): _____

SIGNATURE: _____ DATE: _____

(Designate Appropriate Classification Below)

- | | |
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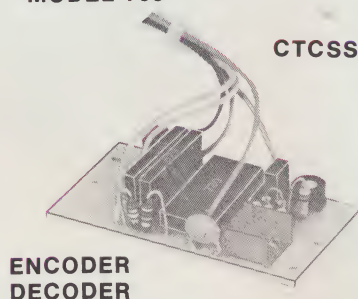
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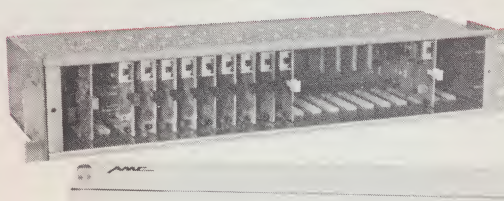


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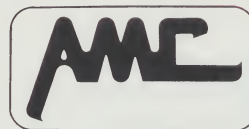
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INFO/CARD 31

This proposal for "one version of how the spectrum use allocation could be implemented" was presented at the July 1979 NABER Annual Meeting.

The Economics Of

Carlos V. Roberts
Chief, Private Radio Bureau
Federal Communications Commission

I know many of you are vitally interested in, and perhaps concerned about, proposals to introduce economics into the land mobile spectrum management process. I would like to take the next few minutes to present to you some basic ideas and concepts on the subject of spectrum economics, in hopes that by initiating a dialogue between users, dealers, coordinators, manufacturers, and government regulators we can come to a better understanding of the issues involved. Let me begin by stating that I, like most of you, do not believe in change merely for the sake of change. If we are going to depart from a well established and long held set of procedures for spectrum management, I believe it is incumbent upon those who advocate such a change to explain just what is wrong with the present system and how the new system will solve the problems. So, I want to begin my talking about four specific weaknesses that are built into the present way in which we at the FCC manage land mobile spectrum.

Four Specific Weaknesses

First, the present system does not provide a mechanism whereby business users who have critical needs for a high quality, two-way mobile communications system can be guaranteed an opportunity to operate such a system. For example, if you are a businessman and you decide that you must have an exclusive radio channel to yourself, and you cannot tolerate sharing a frequency with other users, for whatever reason, then I believe that you should have the option of owning such a radio system, if you are willing to pay for it. Unfortunately, our present system of licensing is designed so that it averages out the quality of service among users and insures that the loading of channels within a band is essentially equal, especially in congested areas. Thus, the government is effectively denying you the freedom of choice that would enable *you* to decide just how important two-way radio is to the conduct of your business and to acquire a system of the level of quality and performance that you feel you need. I believe this is a serious deficiency, and one that results in significant inefficiency and waste due to the inability of business users to use land mobile radio most productively.

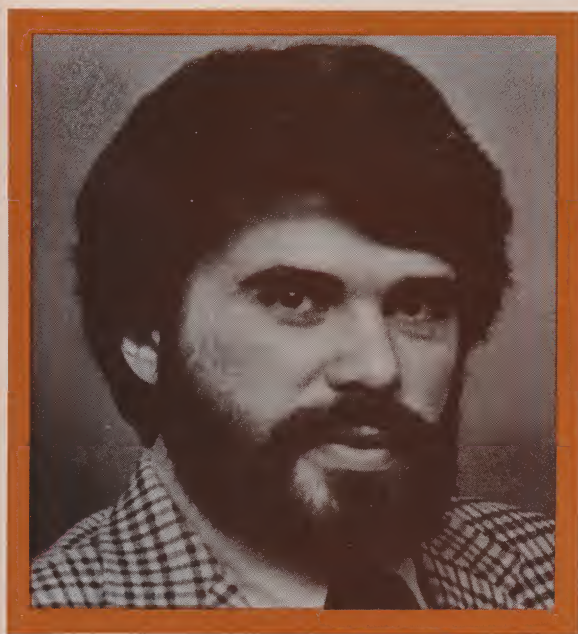
Second, as many of you know, it is possible to lower the cost of radio equipment by increasing the amount of spectrum the equipment uses. As long as spectrum remains a free quantity, it is in the interest of the manufacturers to utilize as much spectrum as possible and, thereby, minimize

*"I think all of us
probably agree that
there has to be a
better way to make
such decisions, and
I believe that the
introduction of
spectrum economics
is an important
part of the answer."*

costs. In order to prevent this from happening, and in the absence of a price being attached to spectrum, the government has to intervene and require that certain minimum standards of spectral efficiency be met in land mobile equipment. There have been many instances of requirements of this type over the years, with perhaps the best known being the various channel-splitting dockets that took place in the 50's and 60's.

More recently, another decision related to spectrum efficiency was made by the FCC in the 800 MHz band. In early May of this year, the Commission decided not to release additional spectrum for conventional land mobile communications at 800 MHz, due to the fact that in that band there is ample spectrum available for use by more efficient trunked systems. The government had to intervene because the land mobile marketplace does not now recognize the economic value of spectrum and spectrum efficiency.

Spectrum Management



The problem with decisions of this type is that, generally speaking, the government winds up making a decision for all users that should really be an individual decision for each user to make. As in the previous example, if a user does not desire to use spectrally efficient equipment, but is willing to pay for the spectrum that he wastes, it seems to me that as an individual entrepreneur and businessman, he should be allowed to do so.

There are other problems associated with governmental decisions on spectrum efficiency. For example, even if there were a certain point in time when the introduction of more efficient technology would be appropriate for all users, that point is extremely difficult to ascertain, and the government can do little more than take an educated guess to determine when that point is reached. Of course, those of us involved in decisions of this type will try to gather as much information as we can as to the need for,

and availability of, more efficient technology, but it should be recognized by all that the final decision is basically an educated guess, modulated by the results of a political process. I think all of us probably agree that there has to be a better way to make such decisions, and I believe that the introduction of spectrum economics is an important part of the answer.

The third area where the present spectrum management policies are seriously defective is the speed in which the process runs. Let's face it; the present process is extremely slow, both in allocating spectrum and in making actual frequency assignments when mutually exclusive competitive applications are involved. I don't think I need to remind anyone that the 800 MHz frequency allocation process, from beginning to end, took just about a decade to complete. That, of course, is for the private land mobile radio services, as the process is still not complete for the common carrier cellular service. This type of delay is frustrating and harmful to prospective users of mobile communications, to the dealers and service people engaged in the industry, and to the manufacturers who supply the equipment. We have to develop a faster and better way of making allocation decisions.

While most applications in the land mobile radio services are not mutually exclusive (i.e., granting one person a license on a given frequency doesn't preclude other people from utilizing that same frequency), there are some services where that is indeed the case. For example, radio common carriers are granted exclusive licenses. It, therefore, is not uncommon to experience long delays when mutually exclusive license applications are filed by competing parties. Some of you have complained to me about having to wait a couple of months before receiving your land mobile licenses, but can you imagine the frustration of having to wait several *years* to become licensed?

As a final critical point, I want to briefly point up the way in which key decisions regarding spectrum use are made within our present system. We are presently making vitally important decisions, on which tens or hundreds of millions of dollars turn, by a process that is subjective and extremely political. As a result, decisions may be made based on inadequate information and on trying to satisfy the wants of the most vocal parties. In other words, we are using an essentially political process to distribute a valuable resource, which makes me somewhat uncomfortable. Generally speaking, I believe that

the political and governmental process is almost always inferior to the marketplace for the distribution of any kind of scarce commodity, whether it be gasoline, land, or spectrum.

A New Approach

Having described some of the shortcomings of our present policies for managing spectrum, let me now describe

"I believe that the political and governmental process is almost always inferior to the marketplace for the distribution of any kind of scarce commodity, whether it be gasoline, land, or spectrum."

a new approach and how it would work. The ideas I'll discuss are one way by which economics can be introduced into spectrum management, but they are by no means the only way that such a change could be made.

What I am proposing is a marketplace for spectrum operating rights, which is in some ways analogous to the manner in which we distribute another valuable commodity, land. Let's quickly review how the land market works. In many parts of the country the permissible uses of land are determined by a zoning board, which decides the

zoning classification of individual lots. Within the general boundaries established by the zoning board, the individual land owner is free to use his land as he or she sees fit. He can sub-divide his lot and build several houses on it, or he can buy an adjoining lot and combine the two, if he needs more space. The land owner is not restricted in any way to whom he sells his property, providing that the new buyer uses it in conformance with the zoning regulations. When an owner wishes to dispose of a piece of property, he goes to a broker, who performs the role of the middleman by bringing the buyer and the seller together. The broker, through the use of various techniques such as multiple listings, etc., stands a much better chance of producing a buyer for the property than if the owner went out and tried to sell it himself, although that is certainly allowed. Once the buyer and seller have met and negotiated a mutually agreeable price, the transaction is consummated. The transaction itself requires no governmental approval. However, after the transaction has taken place, the shift in the title of the land must be recorded, usually in the offices of the local or county government.

FCC Licenses Could Be Traded

Let's now shift our thinking to a system of spectrum management, a system that operates in much the same way as the land market we have been discussing. It is possible to imagine a system based on some type of spectrum property rights, in which those rights are freely traded on the market. The problem with this approach has been the difficulty in defining the actual property rights that are to

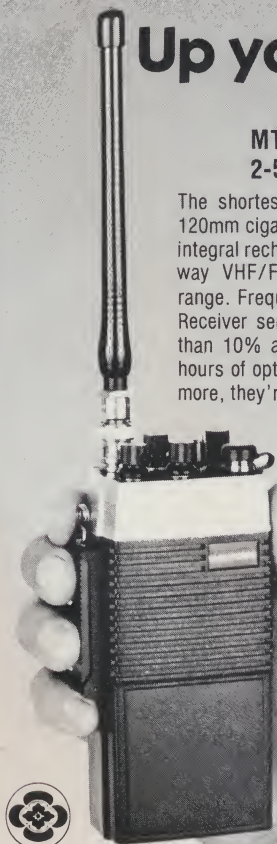
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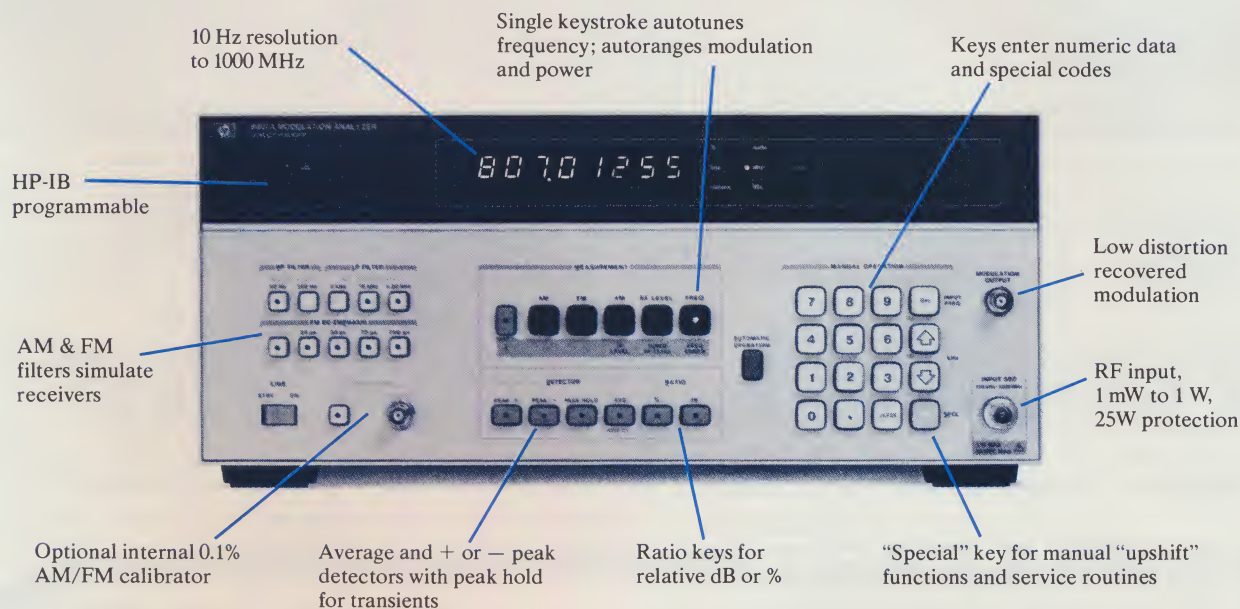


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be traded, which is a necessary condition for a marketplace to operate. However, if, instead of rights, FCC licenses were traded, then a large part of the problem disappears.

For example, let's say that you are a businessman with a license to operate an 800 MHz system from the top of the Sears Tower in Chicago. Due to the advent of new technology, you now find that you don't need as many trucks to carry out your business as you did previously, and thus you decide to cut back the size of your fleet, and the number of mobile transmitters you are authorized to operate. Your initial license was for 40 mobiles, and you decide to drop down to 20 mobiles. You now have an excess capacity of 20 mobiles, which can be made available for some other business to utilize. You then go to a spectrum broker, tell him that you want to sell the operating rights for 20 mobiles in the 800 MHz band, and that you are asking a price of X dollars for these rights. The broker then would list your rights as being for sale and would probably enter your data onto some sort of computerized register which would list other similar offers to sell, along with the asking prices.

At about the same time when you have decided to cut back on your radio system, the chances are very good that a new company has just decided that it needs to get into two-way radio and has a requirement for a number of mobile units operating in the Chicago area. The company then contacts the broker to find out what is available and gives him a desired price change. The broker scans his listings and reports that he has 20 mobile slots available in the 800 MHz band on top of the Sears Tower, and the price is X dollars. If the amount is agreeable to

both parties, the broker draws up the necessary papers to transfer those rights from the first company to the second, and supervises the execution of the papers and the transfer of payment. As soon as the payment is received, the new company can immediately begin to operate on that channel and does not have to wait for any governmental approval. However, the Commission would have to be notified, after the transfer, that a transaction had taken place. This is necessary in order to keep up-to-date records of those entities that are licensed to operate, as well as to gather economic information as to the selling price of spectrum in any given area and frequency band.

This is a relatively simple example, and I am sure that some of you can imagine comparatively complex situations that might raise some interesting questions concerning how the system might function under an unusual set of circumstances. While the concept hasn't been developed to a thoroughly detailed level, I would remind you that society has over the years developed techniques for handling extremely complex transactions in many other natural resource markets, including the one we were discussing earlier, the land market. I have little doubt that any unusual or complicated spectrum requirement could be handled by marketplace forces in a similar manner.

An Often Raised Objection

One objection that I frequently encounter the first time this concept is put forward is the question, "what is there to keep the XYZ company from buying up all the spectrum?" Where I've used XYZ you can insert your own particular nemesis, and depending on your perspective,

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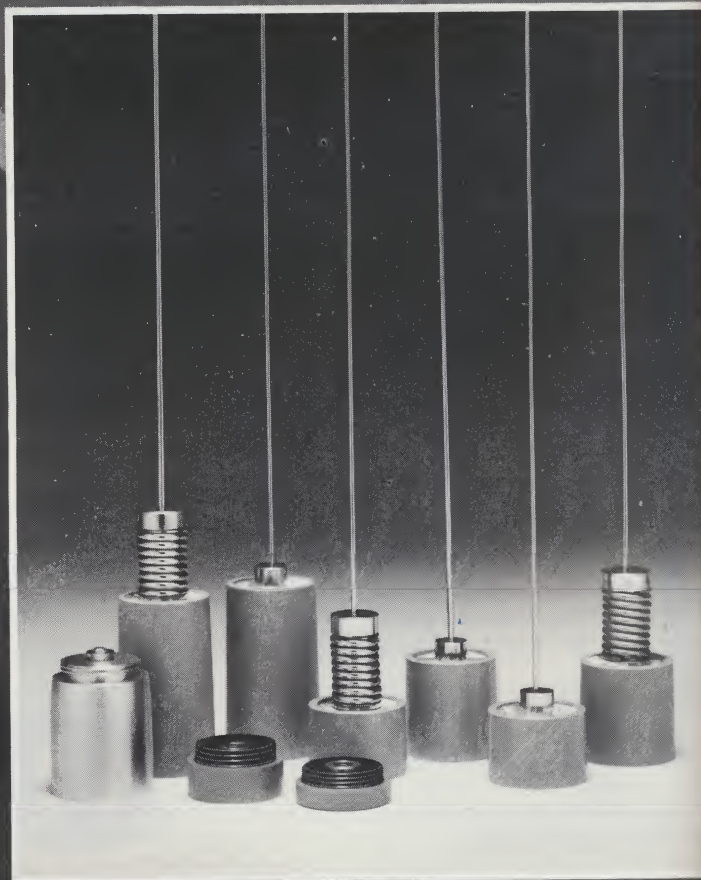
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it might be AT&T, IBM, or the oil companies. The name, of course, is irrelevant. What is important is realizing that what keeps XYZ Company from buying up the rights to all the channels in an area is the same force that keeps from buying all the available land, all the available steel, or all the available timber in an area. That force is simply the economic necessity to justify all expenditures of funds as investments, which must produce a substantial profit for their stockholders. In spectrum, as in the other resources I mentioned, any one company can effectively use only so much, and acquiring any more than it needs becomes a waste of funds and a drain on profits. It is this principle then, and not the lack of sufficient capital, that will keep the spectrum rights from being "bought up" by large corporations.

Benefits to Users

Now that we've briefly discussed the basic concept and how it could operate, let's go over some of the specific benefits that would accrue to users, dealers, and frequency coordinators.

First, the user benefits because, with this system, authorization of service is extremely fast. There is no prior permission to operate required from a government agency. All that needs to be done for someone to get on the air is to find a licensee willing to transfer his rights at a mutually agreeable price; then operation can begin immediately. This process, which could be carried out within a day or two after a decision to purchase mobile radio is made, is much faster than the way our present licensing system

operates. So for users, the first advantage of this system is that when they want to get on the air they can do so very quickly.

A second very important advantage of this method of spectrum allocation to the land mobile user is that it

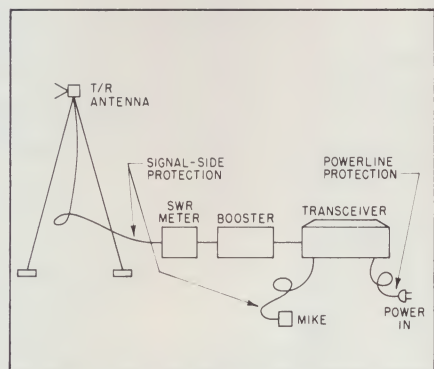
"It is this principle then, and not the lack of sufficient capital, that will keep the spectrum rights from being 'bought up' by large corporations."

provides the ability for the end user to obtain the quality and performance level of communications that he may desire. For example, some business radio users have complained to the FCC about crowded conditions and the effects of congestion in urban areas. Under the approach I'm suggesting here, the maximum amount of congestion would be held to a roughly known value through the application of loading limits for all channels with more than one licensee. Thus, it would be quite feasible for users to decide how much congestion from co-channel users they could tolerate and then select a suitable channel, knowing that they could count on a continued level of performance for years to come, no matter how crowded other land mobile bands might become. In other words, this type of spectrum allocations technique allows the user

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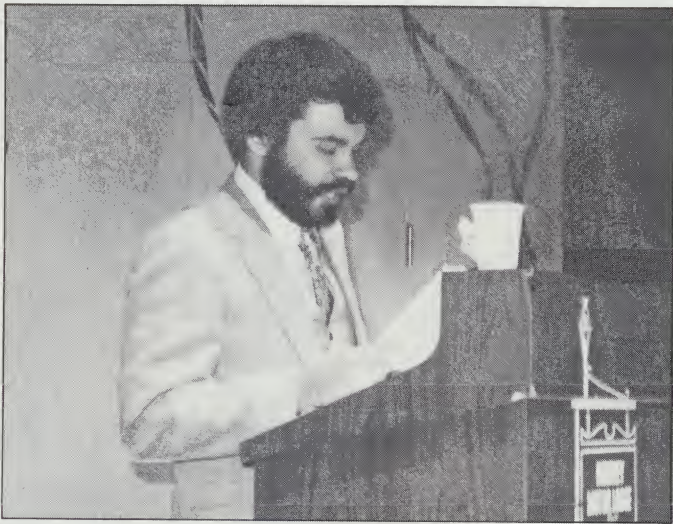
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Private Radio Bureau Chief Carlos V. Roberts delivered his speech on spectrum economics during the FCC workshop.

to have a channel exclusively to himself, if he feels that is important to the conduct of his business and is willing to pay for it.

Conversely, some users have told us at the FCC that they would rather share a channel with other users engaged in similar lines of work, in order to use the radio to call upon their competitors for help when their own company resources aren't available. As an example, consider a plumber who is working at a remote site and discovers that he needs 20 more feet of copper pipe. Rather than

driving all the way back to base to get the required material, he might be able to communicate with another company in the same business, with whom he shares the radio channel, and obtain the pipe he needs from a nearby job site where his competitor may be at work.

In either case, this approach provides the flexibility to allow the user to obtain the type of radio channel he feels is most suitable, whether it be an exclusive frequency or a channel shared with other compatible users.

A third advantage of introducing spectrum economics into the way we manage the radio spectrum is that doing so would allow the user to select the level of spectral efficiency that he would be satisfied with and not have to conform to a general regulation that forces all land mobile users to use trunked equipment, or single sideband modulation, or any one of a number of other techniques for making more efficient use of the spectrum.

As an example, let's discuss a specific case. Let's compare the situation found in a fairly small community, such as Hershey, Pennsylvania, with that found in a large metropolitan area such as New York City. Due to the fact that there is just as much usable spectrum in Hershey as there is in New York City, but there are far fewer would-be users in Hershey, spectrum is not nearly as scarce there as in New York. As a result of this relative lack of scarcity, it doesn't make sense to impose the same requirements for utilizing spectrally efficient equipment in Hershey as it does in New York City. Why should trunked or cellular systems, which are generally more expensive than conventional radio systems, be required in Hershey, even though they make much sense for use in the congested New York

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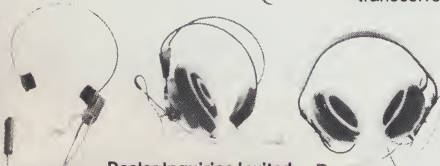
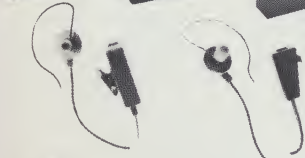


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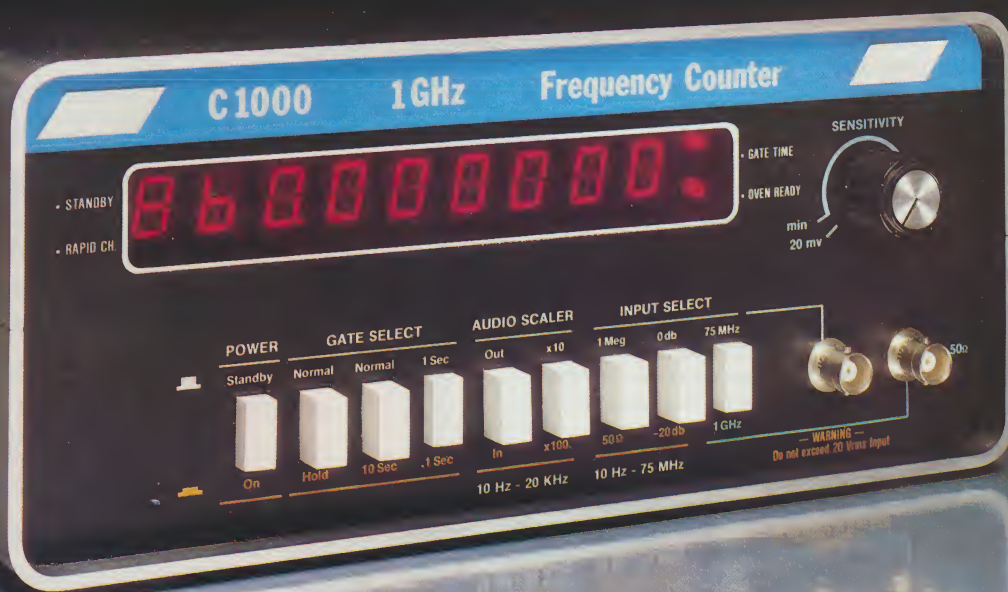
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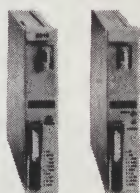
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environment? With the implementation of a spectrum management approach using economics, the government can be removed from the process of setting minimum standards for spectrum efficiency, and those standards can be left up to the desires and interests of individual two-way radio users. Thus, in areas where there are spectrum scarcities, economic considerations will dictate that users will tend to make the most efficient use of the spectrum that they can, while in uncongested rural areas, users may take advantage of the relative abundance of spectrum to utilize cheaper and less efficient radio equipment.

The last major benefit to individual users of two-way radio is of a longer range nature than those I have touched on earlier. As I mentioned, whenever operating rights are bought or traded on the market, there would be a requirement that the FCC be notified of the sale, along with the price for which the rights were sold. The reason for this requirement, in so far as the price information is concerned, is to allow the Commission to closely monitor price trends of operating rights for land mobile channels. In a manner similar to that of our land analogy, the Commission would continue to perform the role of a zoning board for spectrum, setting aside bands that would be available for the operation of broadcasting, land mobile, common carrier, and other services. In order to perform this function in the most efficient manner, and to be sure to assign spectrum to that class of user which will make the most valuable use of the resource, it is imperative

"With the implementations of a spectrum management approach using economics, the government can be removed from the process of setting minimum standards for spectrum efficiency, and those standards can be left up to the desires and interests of individual two-way radio users."

that the Commission know the price that operating rights in different segments of the spectrum are selling for.

For example, if the Commission were to find that land mobile users in a congested area such as New York City are willing to pay \$100 to obtain authority on a land mobile channel, but broadcasting users are only willing to pay \$50 to be allowed to operate on an equivalent amount of bandwidth, then this provides a very useful signal to the Commission. The difference in price indicates that there may not be enough spectrum allocated to land mobile in comparison to broadcasting, and that perhaps a reallocation or a rezoning procedure is in order. Of course, the price paid per unit bandwidth is only one indication of the need for reallocation, but in my mind it is a very significant and important piece of data that we now lack. I suspect that if this type of economic information were available to the Commission for use in reallocation proceedings, land mobile users would benefit by having a significantly easier time in acquiring the

Communications

amount of spectrum needed to satisfy the mobile communication requirements of two-way radio users.

While land mobile communications are not now in a period of spectrum shortage, thanks to the Commission's action in the 800 MHz band, I believe that this is a temporary situation, which will be eventually followed by a period of spectrum shortage and congestion. When that occurs, spectrum economics will be a useful tool in insuring that the spectrum needs of the land mobile community are quickly and fully met.

Benefits to Dealers

For the last few minutes I have been discussing the benefits that the users of land mobile communications can receive from a change in our spectrum management policy. But, what about those companies that are engaged in the sales and service of two-way equipment, your PMRSS members? They, too, could receive many benefits from this approach. I am sure that the radio equipment dealers would find most attractive the ability to get someone on the air within a day or two of the time that the decision is made to purchase land mobile radio equipment. I say this because I suspect there is a sizable number of sales that are lost today simply because the would-be land mobile user gets discouraged by delays in the licensing process. Because of this ability to put users on the air within a fairly short time period, the temptation for a dealer or for his salesman to put equipment on the air before the license is received would disappear, thus freeing the dealer and the customer of the many legal problems associated with unlicensed operation.

Another advantage to the dealers and sales organizations is that through the use of spectrum economics, a customer will have access to the type of spectrum he needs to get the kind of service that is required for the operation of his company. Due to the fact that customer satisfaction is bound to be higher when he can obtain a level of service matching his requirement, I believe that an increased use of radio will result, which will be translated to an increased sales volume for dealers and manufacturers.

Under the new approach, no minimum standards of spectrum efficiency would be required. As a result, I believe that in most parts of the country relatively inefficient equipment could be utilized, which would provide good performance at a minimum cost, and would thus open the land mobile market to many firms that are not presently utilizing this type of equipment, or utilizing it only sparingly. Again, more sales would result.

Finally, because reallocation of spectrum to land mobile needs would, I believe, be more likely under this proposal than under our present practices, there would always be an ample supply of spectrum available, so that the sale and use of land mobile equipment would not be limited by the availability of spectrum and increased congestion, as it has so often been in the past.

Benefits to Frequency Coordinators

Now that we have discussed some of the advantages for the end user and the two-way radio dealer in implementing a system of spectrum management involving economics, we might want to ask ourselves, "Is there anything in this idea that will benefit the coordinating

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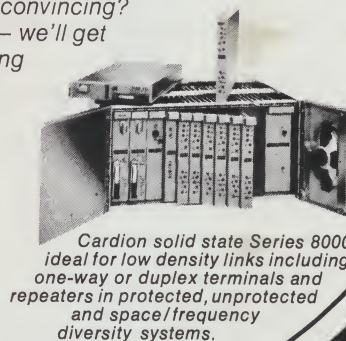
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bodies?" Of course, anything that benefits the users, especially in as many important ways as this approach would, is by definition a benefit to the coordinating group, since they represent the interests of the users. And, in the special case of NABER, because dealers and service organizations are a very active part of the organization through the PMRSS Section, the many aspects that benefit equipment sales will also benefit them, and thus indirectly promote the interests of the coordinating body which also represents them. However, are there any direct benefits that accrue to the coordinating organization if this approach were to be implemented? I believe there are at least two, and I would like to discuss them here.

First, I have already mentioned several times the role that the broker plays, both in the land analogy and in discussing the concept of a spectrum rights market. I believe the broker's role is a natural role for the coordinating committees to assume. The coordinating committees, with their complete and up-to-date bases, their knowledge of the land mobile communications services, and their particular detailed knowledge of the individual characteristics of licensees in the service for which they are performing coordination, would be by far the best equipped to handle the brokering function between existing and new users of land mobile communications.

The second important role for coordinators under this approach could be to perform the function of checking and approving transactions to make sure that they are technically correct. For example, once again turning to our land analogy, someone has to check and make sure that the same piece of land is not sold to two different people

and registered under two different owners. This is a process known as performing a title search. That same function would have to be performed in the spectrum market, and I believe the coordinating bodies are ideally suited to play this role. For example, if a land mobile channel has a loading limit of 100 mobiles, and a user sells his rights to operate 20 mobiles on that channel, it is imperative that a check be made to insure that (a) the user has been properly licensed and has the rights to sell in the first place, and (b) if any change in location of the transmitting equipment is proposed, that it will not

"The coordinating committees... would be by far the best equipped to handle the brokering function between existing and new users of land mobile communications."

conflict with co-channel users. Again, because of their expertise and detailed knowledge of the land mobile communications field and the user population, as well as because of their extensive data bases, the coordinating body would be the logical entity to perform this function.

Due to the importance of the role that coordinators could play in implementing the spectrum economics approach, as well as their valuable role in the present practices

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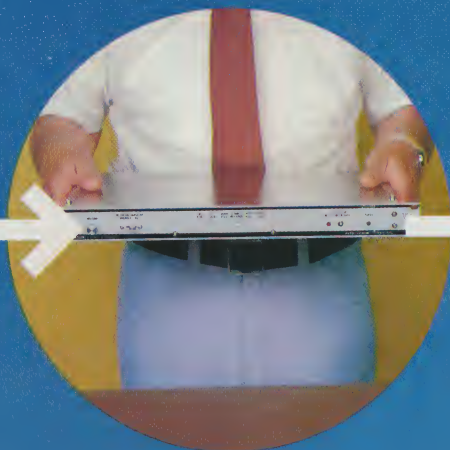
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and procedures of the land mobile community, I have strongly supported changes in the Communications Act to provide more authority, together with legislative recognition, for land mobile coordinating committees. Additionally, because of the important and very useful role that coordinating committees could play in the implementation of this approach, a valuable opportunity is provided these groups to become integral players in the activities taking place in the 800 MHz band. As you know up to now, licensing in this band has taken place without the type of coordination found in the lower frequency

“Because this concept represents a somewhat radical departure from the present way we carry out licensing and assignment in the land mobile radio services, I believe it is best to go slow in the implementation of any new changes.”

bands. However, if legislation authorizing the introduction of spectrum economics were passed, and if the Commission should decide to implement such a program, I would be prepared to recommend an important and major role, along the lines I have described, for coordinating committees in the 800 MHz band. This, of course, would be in

addition to the continuation of their participation in activities in the lower bands.

How Idea Can Be Implemented

What I have described is, in essence, the conceptual framework that could be used to implement spectrum economics in the land mobile radio services. If you agree with me that the benefits of such an approach make it worthy of serious consideration, your next question may be, “How do we get there from here?” Of course, the first requirement is the passage of new legislation, or amendments to the present Communications Act. Assuming that this event takes place, and I believe we will know one way or the other in the next few months, the next step would be for the Commission to implement this approach through a rule making proceeding.

Because this concept represents a somewhat radical departure from the present way we carry out licensing and assignment in the land mobile radio services, I believe it is best to go slow in the implementation of any new changes. One possible approach would be to conduct a test program using part of the 800 MHz band, while continuing our present policies for the rest of the land mobile spectrum. We might wish to select a group of channels, say 100 for example, and use these as the initial test spectrum for the new program. Rather than assign these 100 new channels to new applicants who file regular license applications with the Commission, as we do now, I would suggest that operating rights on these frequencies be auctioned off and awarded to the highest bidders. This process is desirable because if licenses are simply awarded



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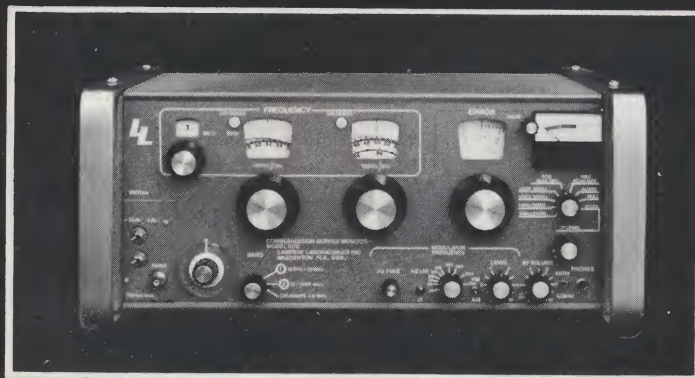
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without charge on a first come, first served basis, there exists the possibility that many individuals will file for licenses that they have no intention of using, simply to be able to resell them at a later date and collect "windfall" profits. Even if the licensee does purchase equipment and uses the channel for a year or two, and later sells his rights at a large profit, this would seem somewhat inequitable, because he acquired the spectrum rights free. There-

"In summary, this approach to spectrum economics is a concept that combines an initial auction of channels, followed by a free marketplace for the trading of operating, rights on those channels."

fore, the concept of an auction guarantees that those who purchase operating rights will pay the going market price and whether or not they will profit, when the rights are sold, depends on the market value of the rights at the time of sale.

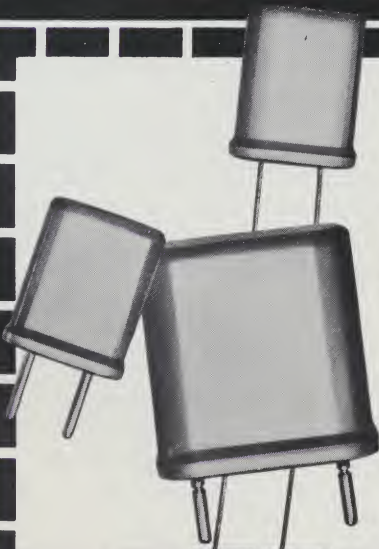
How often these auctions would occur is a question that would have to be resolved as some experience is gained with the operation of the program. However, I would lean toward making a majority of the land mobile

spectrum in the 800 MHz band available for use on a rapid basis. I favor this approach because spectrum is a non-renewable resource, and every day that it goes unused is a day that it has been wasted. In fact, I believe the principal reason why the entire 800 MHz band is not available for use today is because under our present system of assignment and allocations, once an allocation is made to a specific type of use it is nearly impossible to come back and alter that decision, due to the high cost of equipment invested and the political power wielded by operating licensees. However, under a marketplace trading system, any new use of spectrum that came along and was more profitable than the existing use could purchase operating rights from the existing users, and thus new technologies and services could be readily implemented. This then renders unnecessary the holding of large amounts of spectrum in a resource capacity, especially since the cost of holding that spectrum unused over a period of time can be very high.

In summary, this approach to spectrum economics is a concept that combines an initial auction of channels, followed by a free marketplace for the trading of operating rights on those channels. The advantages of this concept are many, and they accrue to users, dealers, coordinators, and manufacturers. I hope in the brief amount of time I have been able to devote to this important idea, I have succeeded in stimulating your curiosity and interest, and I look forward to being able to have a discussion with you, at this time next year, on exactly how we will implement this new approach to land mobile licensing and regulation. □

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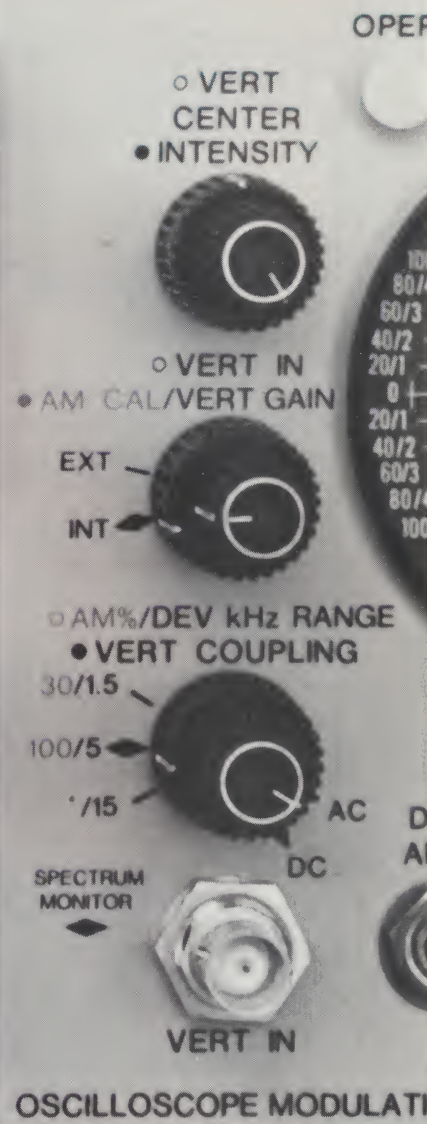
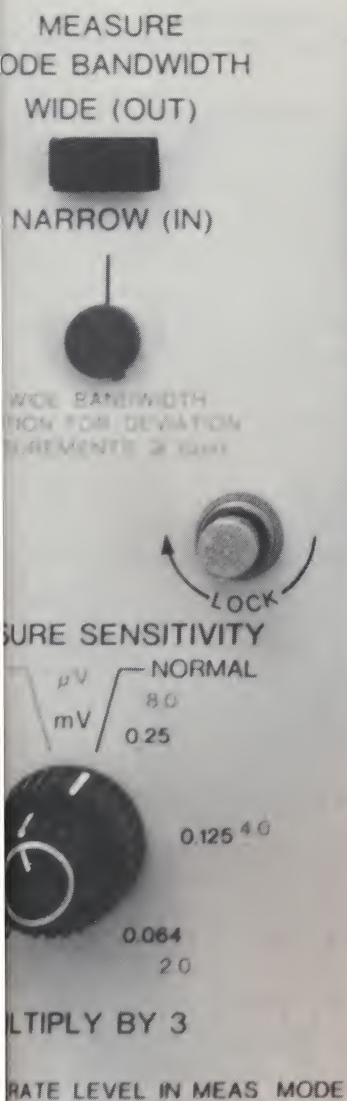


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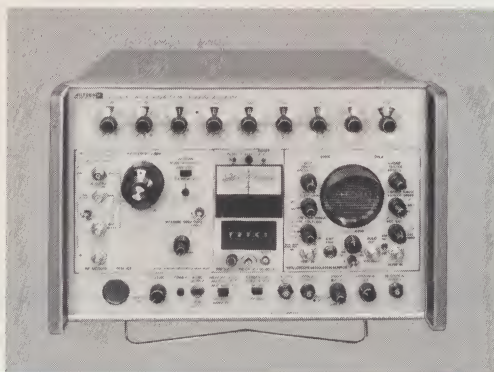
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Thomas L. Hamilton was appointed manager, District Sales, for RCA Mobile Communications Systems. With offices in East Orange, N.J., Hamilton will be responsible for the sale of two-way radio communications equipment to government and commercial customers in northern New Jersey.

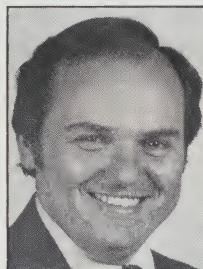
Before joining RCA, he was an account executive for Motorola C&E Inc., where he held several other sales positions.

Rich Bohmer is Repco's new special products engineer for RF communications links. Prior to joining Repco, he specialized in state and local government for the State of New Jersey as district sales manager for Motorola. In his new position, Bohmer is responsible for the organization and direction of the RF Links product line.

Aurora Marketing Company has announced the appointment of **Richard Hunt** as its Utah office manager. Headquartered in Ogden, Utah, he has responsibility for sales in Utah, southeastern Idaho, and western Wyoming. Hunt has over ten years of experience in the two-way radio field.



Hunt



Mitchell

George J. Mitchell has been promoted to director of MAXAR Product Operations, Communications Products Division, Motorola Inc. Previously

he was product manager of the MAXAR product line. Mitchell has been associated with the electronics industry for the past 17 years, including five years with Motorola.

Sidney T. Kitrell was named to director of marketing of Hy-Gain Electronics amateur radio, CB, marine and land mobile antennas. Kitrell assumes the new responsibility in addition to his present post as director of marketing for the Telex Aviation Products group. He will work out of both the Hy-Gain facilities in Lincoln, Nebraska, and the Telex headquarters in Minneapolis.

George E. Daley has been appointed to the position of midwest regional sales manager for Leasametric. Daley previously was employed by Hewlett-Packard as a computer systems sales representative. □

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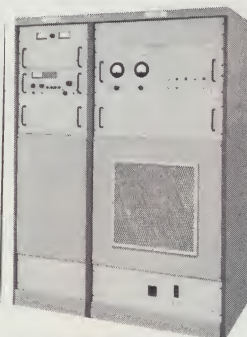
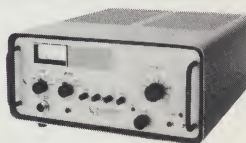
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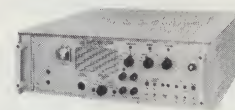
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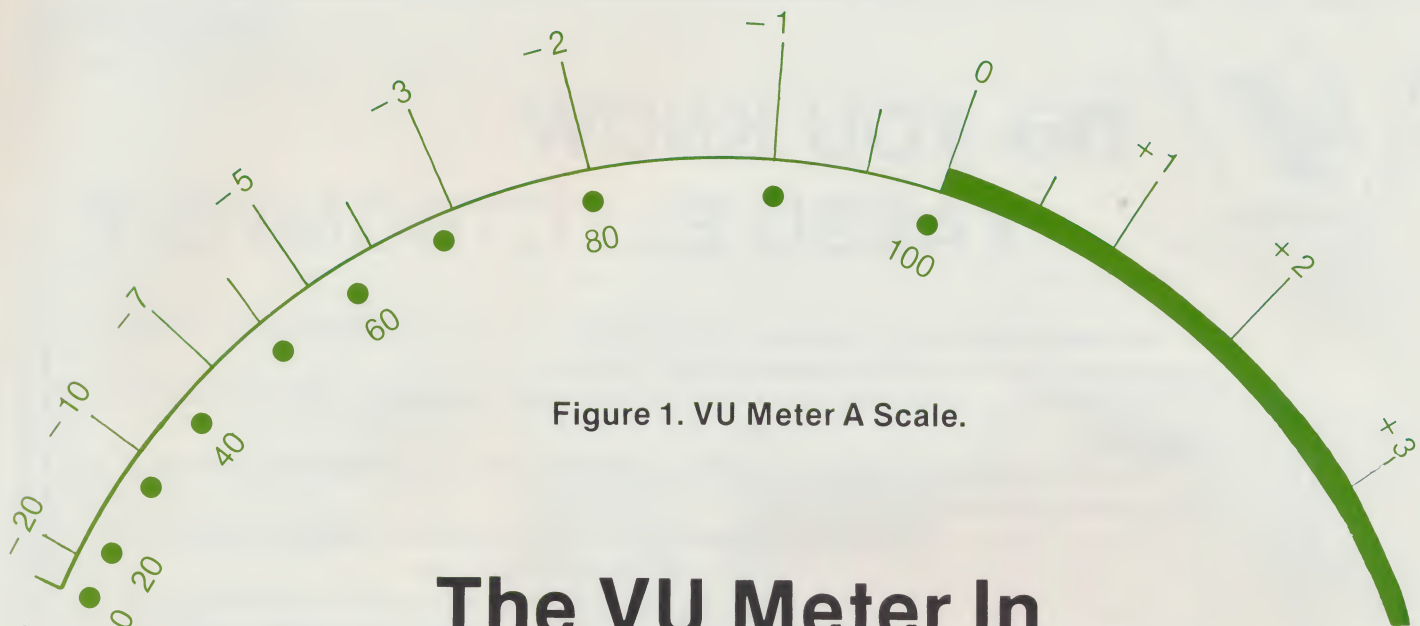


Figure 1. VU Meter A Scale.

The VU Meter In Two-Way Communications

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The meter is available with either of two scale arrangements, which are called the A and B scales. The A scale

is shown in Figure 1. The upper scale reads from -20 to +3 VU while the lower scale is calibrated from 0 to 100 where the 100 mark coincides with 0 VU at about 70 percent of full scale deflection. The A scale is preferred for communications applications while the B scale, which has the same two scales transposed, is preferred for broadcast applications. Other than the difference in scale appearance, the meters are identical and can be used interchangeably.

The meter consists of a sensitive 200 microampere d'Arsonval movement and a copper oxide full wave bridge rectifier. The rectifier is required to transform AC signals into DC voltages because the basic meter movement responds to DC voltages only. The internal resistance of the meter movement and rectifier appear as an equivalent resistance of 3,900 ohms to an external circuit. If we were to connect the meter directly across a 600 ohm line, the meter would present too low a resistance. Moreover,

the inherent non-linear rectifier would have a tendency to increase distortion in the line. Good audio engineering practice requires that the resistance of the meter be at least ten times the resistance of the external circuit to which it is connected. In the case of a VU meter that is reading speech levels on a 600 ohm line, the meter resistance must be at least 6,000 ohms.

The easiest way to make the meter look like a high resistance is to simply add an external series resistor, provided we make allowances for the signal voltage loss due to the external resistor. It is common practice in the recording and broadcast industries to add a 3,600 ohm resistor in series with the meter. This results in a total meter resistance of 7,500 ohms. Remember that the 6,000 ohms bridging resistance is a recommended minimum value only and not an absolute requirement. As far as the meter is concerned, it is looking into an external circuit resistance of 3,900 ohms, which is the sum of the 3,600 ohms resistor

and the line in parallel with its termination. It is important that the meter see an external resistance of 3,900 ohms. This is necessary in order to maintain the ballistic characteristics of the meter. The 3,600 ohms resistor introduces a 4 VU loss between the line and the meter, but this is of no particular consequence as long as we remember to mentally add 4 VU to the meter reading.

Signal Value

The telephone company, which owns and leases practically every line over which voice signals are sent, specifies that the signal not exceed a certain maximum value. The maximum allowable signal value is a compromise between two conflicting requirements. On the one hand, the signal should be high enough to insure an acceptable signal to noise ratio. This means that the signal should be substantially louder than line hum and noise. On the other hand, the signal must not be so high as to cause crosstalk interference due to interconductor leakage to adjacent circuits. The telephone company has specified the maximum speech level on a line to be +8 VU.

If we connect a VU meter with external resistor of 3,600 ohms across a line carrying +8 VU of speech, the pointer will go off scale. Allowing for a loss of 4 VU due to the resistor, the meter is trying to indicate +4 VU, which is off scale because the upper scale limit is only +3 VU.

We can reduce the level put into the line in order to make the pointer indicate on scale, but this is inadvisable because it will degrade the signal-to-noise ratio at the base station end of the line. Keep in mind that there is almost always an unavoidable reduction in signal due to the loss in-

herent in the line. That is why it is important to operate the system with the maximum allowable signal level on the line.

We get around the difficulty by adding another loss network to the meter and while so doing, establish a new reference so that the pointer indicates 0 VU when there is a +8 VU on the line. This means that the added network must introduce an additional loss of 4 VU for a total of 8 VU ahead of the meter. A T-pad using standard resistance values will provide the additional loss and maintain the desired impedance relationship. The VU meter circuit is shown in Figure 2. With this circuit, the meter looks into 3,900 ohms, the line is bridged with 7,500 ohms, and the network provides a loss of 8 VU. The network very neatly satisfies the requirement to present a 3,900 ohm load to the meter, presents a high resistance to the line, and introduces a loss of 8 VU.

When we say that a speech level of +8 VU exists on a line, we mean that there exists a fluctuating voltage with an effective value equivalent to a sinewave signal of +8 dBm. This says nothing about the peaks instantaneously reached by the fluctuating complex signal voltage. These peaks are too short for the meter to follow due to meter inertia. The difference between the average value and the instantaneous peaks is known as the peak factor and is of the order of 10 dB for speech with no compression. With speech compression such as is commonly used in communications circuits, careful measurements show that the peak factor is reduced to about 6 dB. This means that the instantaneous peaks reach a maximum value of +14 dBm, and so the line amplifier must have an output rating of at least +14 dBm in order to pass

the peaks without distortion. The peaks can be measured with an oscilloscope or peak reading voltmeter.

How to Interpret The Reading

The most difficult part in using a VU meter is knowing how to interpret the reading. The meter indicates somewhere between the average and maximum instantaneous speech level, and there is no simple relationship between the meter reading and the power in the speech waveform, which will differ for different talkers. The correct way to read the meter is to regard the average indication of the three highest peaks in a ten second time interval, disregarding occasional extreme peaks, as the loudness in VU. Incidentally, when checking a speech circuit, have the dispatcher say "Joe took father's shoe bench out" and "She was waiting at my lawn" because these sentences contain all of the fundamental sounds of the English language. The talking circuit should be adjusted so that the pointer indicates to the 0 VU mark for a majority of the peak swings.

Sometimes, for one reason or another, it is required to adjust the talking circuit by using a steady tone signal. The peak factor is 0 when transmitting a steady sinewave tone, and the circuit should be adjusted for a steady sinewave signal level 6 dBm above the speech level in VU. For a line level of +8 VU of speech, the steady sinewave tone level will be +14 dBm which corresponds to 3.9V RMS. Steady sinewave tone signals can also be measured with a dB meter or an AC voltmeter such as a Simpson 260.

A tone level of +14 dBm will cause the VU meter to go off scale. This problem is corrected by opening the

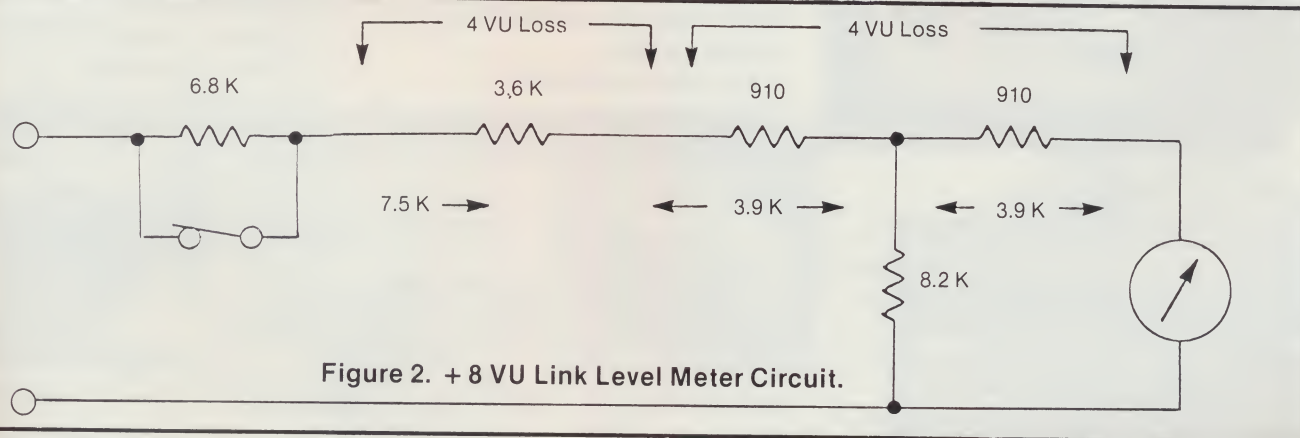


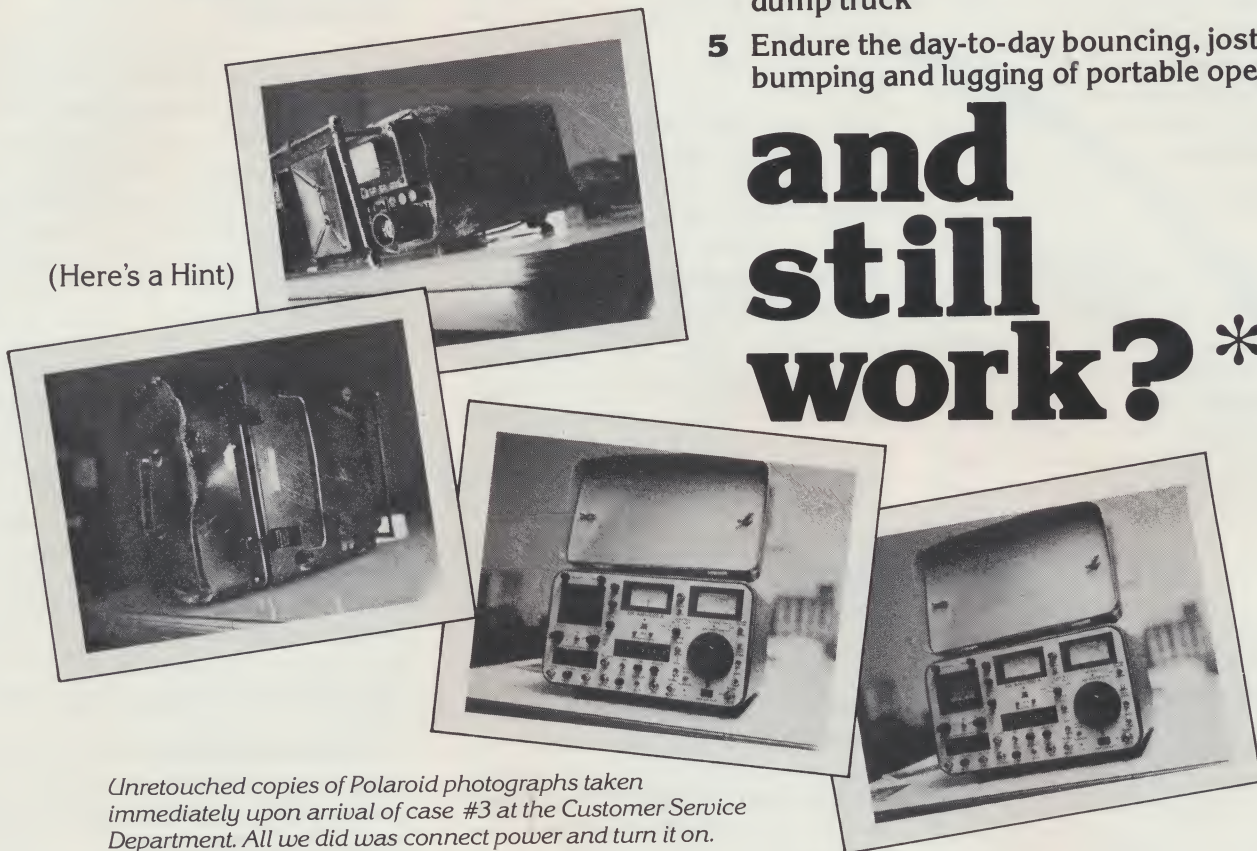
Figure 2. +8 VU Link Level Meter Circuit.

what can

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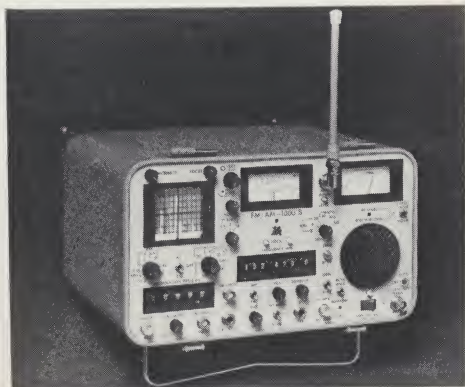
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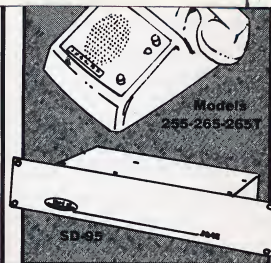
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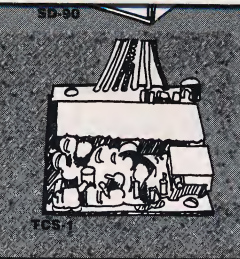
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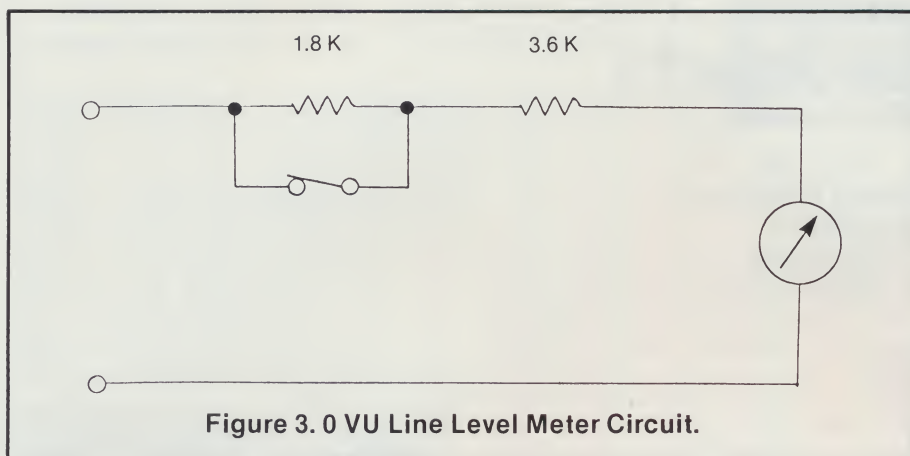


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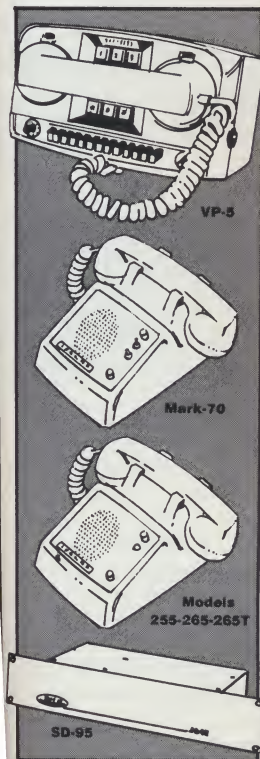
switch and a 6.8K resistor to bring the pointer back on scale to the 0 VU mark. The impedance relationship is lost, but we are not concerned with meter ballistics when reading a steady sinewave signal.

If the local telephone company specifies a maximum speech level of 0 VU, the meter circuit must be changed to that shown on Figure 3. In this instance, the 3.6K resistor will cause the meter to indicate a -4 VU with 0 VU of speech on the line. Under these conditions, the steady tone signal can be set to +6 dBm. The 1.8K

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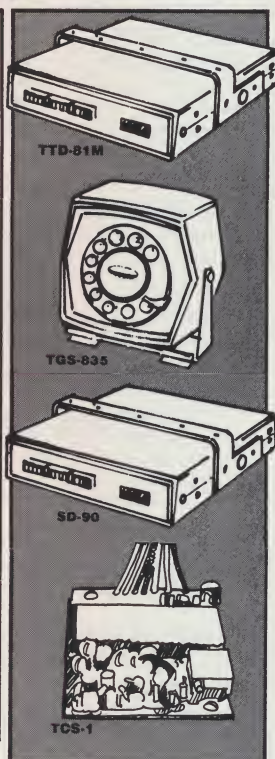
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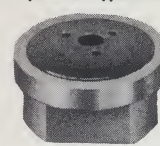
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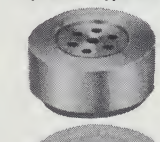
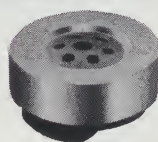
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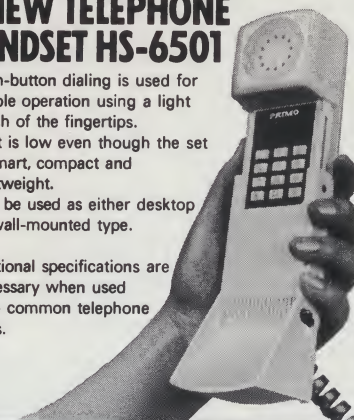
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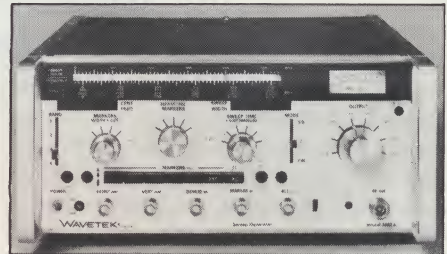


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2SA 473	45	53	2SC 756A	150	160	2SC 2026	50	64	TA 7045M	200	220
2SA 484	190	210	2SC 756B	150	160	2SC 2026A	50	64	TA 7055M	200	220
2SA 485	190	210	2SC 776	200	220	2SC 2076	50	64	TA 7060P	90	110
2SA 488	110	125	2SC 776A	200	220	2SC 2076A	50	64	TA 7060P	90	110
2SA 495	25	35	2SC 777	200	220	2SC 2092	160	200	TA 7062P	110	125
2SA 497	120	130	2SC 778	200	220	2SC 2092A	160	200	TA 7062P	110	125
2SA 509	30	35	2SC 784	200	220	2SC 2098	320	340	TA 7062P	110	125
2SA 537A	150	170	2SC 784A	200	220	2SC 2101	30	40	TA 7062P	110	125
2SA 561	30	35	2SC 789	80	90	2SC 2101A	30	40	TA 7062P	110	125
2SA 562	30	35	2SC 789A	80	90	2SC 2101B	30	40	TA 7062P	110	125
2SA 534	40	45	2SC 793	200	220	2SC 2101C	30	40	TA 7062P	110	125
2SA 643	30	40	2SC 793A	200	220	2SC 2101D	30	40	TA 7062P	110	125
2SA 673	30	40	2SC 793B	200	220	2SC 2101E	30	40	TA 7062P	110	125
2SA 683	40	53	2SC 793C	200	220	2SC 2101F	30	40	TA 7062P	110	125
2SA 684	40	53	2SC 793D	200	220	2SC 2101G	30	40	TA 7062P	110	125
2SA 694	40	53	2SC 793E	200	220	2SC 2101H	30	40	TA 7062P	110	125
2SA 699A	40	53	2SC 793F	200	220	2SC 2101I	30	40	TA 7062P	110	125
2SA 706	65	100	2SC 793G	200	220	2SC 2101J	30	40	TA 7062P	110	125
2SA 719	25	35	2SC 793H	200	220	2SC 2101K	30	40	TA 7062P	110	125
2SA 720	25	35	2SC 793I	200	220	2SC 2101L	30	40	TA 7062P	110	125
2SA 733	20	27	2SC 793J	200	220	2SC 2101M	30	40	TA 7062P	110	125
2SA 744	420	440	2SC 793K	200	220	2SC 2101N	30	40	TA 7062P	110	125
2SA 759	360	400	2SC 793L	200	220	2SC 2101O	30	40	TA 7062P	110	125
2SA 767	420	440	2SC 793M	200	220	2SC 2101P	30	40	TA 7062P	110	125
2SA 847	40	53	2SC 793N	200	220	2SC 2101Q	30	40	TA 7062P	110	125
2SB 54	30	40	2SC 793O	200	220	2SC 2101R	30	40	TA 7062P	110	125
2SB 55	40	53	2SC 793P	200	220	2SC 2101S	30	40	TA 7062P	110	125
2SB 75	30	40	2SC 793Q	200	220	2SC 2101T	30	40	TA 7062P	110	125
2SB 77	30	40	2SC 793R	200	220	2SC 2101U	30	40	TA 7062P	110	125
2SB 186	20	27	2SC 793S	200	220	2SC 2101V	30	40	TA 7062P	110	125
2SB 187	20	27	2SC 793T	200	220	2SC 2101W	30	40	TA 7062P	110	125
2SB 324	25	35	2SC 793U	200	220	2SC 2101X	30	40	TA 7062P	110	125
2SB 367	110	125	2SC 793V	200	220	2SC 2101Y	30	40	TA 7062P	110	125
2SB 405	25	35	2SC 793W	200	220	2SC 2101Z	30	40	TA 7062P	110	125
2SB 407	70	90	2SC 793X	200	220	2SC 2101A	30	40	TA 7062P	110	125
2SB 434	60	80	2SC 793Y	200	220	2SC 2101B	30	40	TA 7062P	110	125
2SB 473	70	90	2SC 793Z	200	220	2SC 2101C	30	40	TA 7062P	110	125
2SB 474	70	90	2SC 793A	200	220	2SC 2101D	30	40	TA 7062P	110	125
2SB 507	70	90	2SC 793B	200	220	2SC 2101E	30	40	TA 7062P	110	125
2SB 511	70	90	2SC 793C	200	220	2SC 2101F	30	40	TA 7062P	110	125
2SB 536	100	120	2SC 793D	200	220	2SC 2101G	30	40	TA 7062P	110	125
2SB 567	210	230	2SC 793E	200	220	2SC 2101H	30	40	TA 7062P	110	125
2SB 595	110	140	2SC 793F	200	220	2SC 2101I	30	40	TA 7062P	110	125
2SB 596	110	140	2SC 793G	200	220	2SC 2101J	30	40	TA 7062P	110	125
2SB 600	500	600	2SC 793H	200	220	2SC 2101K	30	40	TA 7062P	110	125
2SC 163	40	53	2SC 793I	200	220	2SC 2101L	30	40	TA 7062P	110	125
2SC 184	40	53	2SC 793J	200	220	2SC 2101M	30	40	TA 7062P	110	125
2SC 261	25	35	2SC 793K	200	220	2SC 2101N	30	40	TA 7062P	110	125
2SC 372	20	27	2SC 793L	200	220	2SC 2101O	30	40	TA 7062P	110	125
2SC 373	20	27	2SC 793M	200	220	2SC 2101P	30	40	TA 7062P	110	125
2SC 380	20	27	2SC 793N	200	220	2SC 2101Q	30	40	TA 7062P	110	125
2SC 381	20	27	2SC 793O	200	220	2SC 2101R	30	40	TA 7062P	110	125
2SC 382	20	27	2SC 793P	200	220	2SC 2101S	30	40	TA 7062P	110	125
2SC 383	20	27	2SC 793Q	200	220	2SC 2101T	30	40	TA 7062P	110	125
2SC 384	20	27	2SC 793R	200	220	2SC 2101U	30	40	TA 7062P	110	125
2SC 385	20	27	2SC 793S	200	220	2SC 2101V	30	40	TA 7062P	110	125
2SC 461	130	140	2SC 793T	200	220	2SC 2101W	30	40	TA 7062P	110	125
2SC 462	110	125	2SC 793U	200	220	2SC 2101X	30	40	TA 7062P	110	125
2SC 463	130	140	2SC 793V	200	220	2SC 2101Y	30	40	TA 7062P	110	125
2SC 495	45	55	2SC 793W	200	220	2SC 2101Z	30	40	TA 7062P	110	125
2SC 497	110	125	2SC 793X	200	220	2SC 2101A	30	40	TA 7062P	110	125
2SC 509	30	40	2SC 793Y	200	220	2SC 2101B	30	40	TA 7062P	110	125
2SC 517	300	320	2SC 793Z	200	220	2SC 2101C	30	40	TA 7062P	110	125
2SC 525	30	40	2SC 793A	200	220	2SC 2101D	30	40	TA 7062P	110	125
2SC 527	130	145	2SC 793B	200	220	2SC 2101E	30	40	TA 7062P	110	125
2SC 596	100	120	2SC 793C	200	220	2SC 2101F	30	40	TA 7062P	110	125
2SC 710	20	27	2SC 793D	200	220	2SC 2101G	30	40	TA 7062P	110	125
2SC 711	20	27	2SC 793E	200	220	2SC 2101H	30	40	TA 7062P	110	125
2SC 712	20	27	2SC 793F	200	220	2SC 2101I	30	40	TA 7062P	110	125
2SC 717	35	45	2SC 793G	200	220	2SC 2101J	30	40	TA 7062P	110	125
2SC 720	300	320	2SC 793H	200	220	2SC 2101K	30	40	TA 7062P	110	125
2SC 732	20	27	2SC 793I	200	220	2SC 2101L	30	40	TA 7062P	110	125
2SC 733	20	27	2SC 793J	200	220	2SC 2101M	30	40	TA 7062P	110	125
2SC 734	20	27	2SC 793K	200	220	2SC 2101N	30	40	TA 7062P	110	125
2SC 735	20	27	2SC 793L	200	220	2SC 2101O	30	40	TA 7062P	110	125

Minimum Order \$5.00

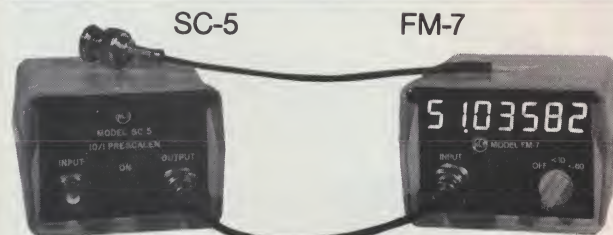
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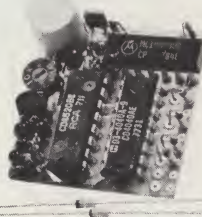


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New — Diode Programmable CTCSS Encoder

The Trans Com 179 diode programmable sub-audible tone encoder eliminates the need for screwdrivers, frequency counters, and an inventory of reeds. Simply insert the proper diodes into the encoder and you're on frequency. The 179 can be easily programmed for any one of the standard EIA tones from 67.0Hz to 203.5Hz.



179 Features:

- Compatible with PL, CG and other CTCSS systems
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- Tone stability ± 15 Hz from -20°C to +70°C
- Available with optional mini dip switch for quick infield frequency change
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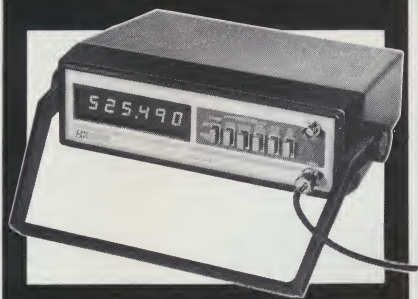
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when desired. \$149.95, less crystals and batteries. Electra Company, P.O. Box 29243, Cumberland, Ind. 46229 (317) 894-1440. INFO/CARD #122.

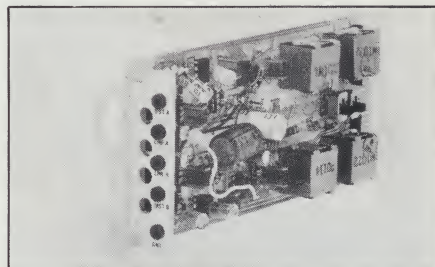
Catalog: Philips

A free catalog, which contains information, technical specifications and illustrations of all current Philips products marketed by PTMI in the United States and Canada is available. The listing groups products by category for reader convenience. These include: oscilloscopes, counters and counter/timers, recorders, signal generators, and radio and TV service. In addition, an extensive list of PTMI sales offices and service locations is included. Philips Test & Measuring Instrument, Inc., 85 McKee Dr., Mahwah, N.J. 07430. (800) 631-7172. Circle INFO/CARD #121.

Amplifier: Dantel, Inc.

Model 90538 VF summing and distribution amplifier is a dual amplifier module that has two sets of distribution amplifiers and summing amplifiers in one assembly. It's useful in voice frequency communications systems for making signal combining

and distribution circuits and also for voice conference bridges or split-data bridges. Each amplifier section features 20 dB of gain or attenuation. Summing and distribution resistors are included on the module as are line transformers. The module con-



sists of a plug-in P.C. assembly that fits into any of Dantel's 8000 or 9000 equipment housings. Dantel Marketing Department, 1922 N. Helm Avenue, Fresno, Calif. 93727. (209) 252-1651. INFO/CARD #123.

Digital Multimeter: Fluke

The hand-held 8020A contains a CMOS LSI analog/digital chip with a sharp liquid crystal display of 2000 digits, providing resolution to 100 microvolts and 100 milliohms. With 26 ranges and seven functions powered by a 200-hour inexpensive 9V battery,



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Tempo MS-2 4 channel scanning receiver for VHF high band. Smallest unit on the market. Scan or manually select channel. Provisions to switch channel one out of the scanning mode.

Tempo MR-2 Same size as MS-2, but has manual selection of 12 channels! VHF high band.

Tempo MR-3 A miniature, 2 channel, VHF high band monitor or paging receiver. Small size makes it more versatile than the MR-2 without sacrificing performance.

Tempo MR-3U Same size as the MR-3 but offers single channel capability on the 400 to 512 UHF band. Each receiver includes: Ni-cad batteries, an AC adaptor/charger, a wire antenna, and an earphone.

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the 8020A provides for precise stable leakage measurements up to 10,000 megohms, making possible new electronic troubleshooting techniques, including measurement of transistor beta. Price \$169. John Fluke Mfg. Co., P.O. Box 43210, Mountlake Terrace, Wash. 98043. (206) 774-2211. INFO/CARD #119.

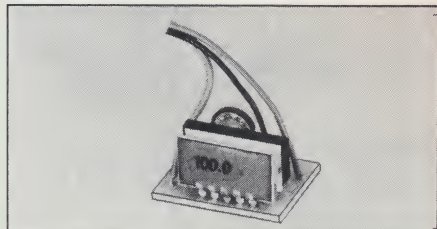
Antenna: Antenna Inc.

A 25-54 MHz 1/4 wave low band antenna (model 41919) for business and municipal applications features a stainless steel swivel ball, stainless steel spring and 96" 17-7PH stainless steel whip. It is supplied with 20 feet of RG-58/U coaxial cable, and connectors.

The antenna is designed for 200 watt power capability, unity gain, and a nominal impedance of 50 ohms. VSWR is 1.5:1 or less. Antenna Inc., 26301 Richmond Rd., Cleveland, Ohio 44146. (216) 464-7075. INFO/CARD #124.

Encoders: American Microsignal Corp.

Model 401 sub-audible tone encoder, and the model 400 sub-audible encoder-decoder can have up to 40 tone frequencies in increments of eight. Frequency stability is $\pm .5$ percent over a temperature range of -30° to $+85^{\circ}\text{C}$, with current requirements less than 4 milliamps at 12.6 volts DC. The unit will also function to specification from



11.0 volts DC to 18.0 DC. The 401 encoder, priced at \$18.75, and the 400 encoder/decoder at \$45, are probably the lowest priced in the industry, according to the manufacturer. American Microsignal Corp., 8431 Monroe Ave., Stanton, Calif. 90680. (714) 761-1222. Circle INFO/CARD #127.

Antenna: Phelps Dodge

The PD-1167 VHF omnidirectional 3 dB gain fiberglass base station antenna is available in the range of 144-174 MHz. The maximum power handling capability is 500 watts. The operating bandwidth for 1.5:1 VSWR is 6 MHz, the vertical bandwidth is 36° . The overall length is 9.3 feet. It is constructed of heavy wall fiber-

glass with the 6061-T6 aluminum support pipe being the only exposed metal. Survival wind velocity with 1/2 in. of radial ice is 100 MPH. Phelps Dodge Communications Co., Rt. 79, Marlboro, N.J. 07746. (201) 462-1880. INFO/CARD #117.

Antenna: Maxrad

5 dB gain UHF antennas have been added to their line of land mobile antennas. All utilize 302 or 17-7 PH stainless steel radiator material and chrome over nickel over copper plated brass mechanical parts. A low profile

1/2 in. high, no holes trunk lid mounting is available. Power ratings are 150 to 200 watts. Model MUF-4405 (440-460 MHz) and MUF-4505 (450-470 MHz) are available now. Pricing is competitive. Maxrad, 9962 W. Bryn Mawr Ave., Rosemont, Ill. 60018. (312) 671-7400. INFO/CARD #126.

Instruments Catalog: Leader

The new catalog includes complete features, specifications, and applications for more than 50 instruments, in addition to probes and other acces-

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series. A total of 11 oscilloscopes, ranging in bandwidth from 4 to 30 MHz are included. Also described are a group of meters and bridges, video generators, RF test instruments, transistor testers, and a new series of eight instruments designed for special applications. Leader Instruments Corp., 151 Dupont St., Plainview, N.Y. 11803. (516) 822-9300. INFO/CARD #128.

2 Meter Yagi: Cushcraft

Cushcraft introduces the new Boomer 3.2 wavelength yagi for two meter DX amateur band communications. The antenna exhibits 16.2 dBd forward gain and 24 dBd front to back ratio. It has a high efficiency balanced feed system with integral balun. Mechanical features include a large diameter round boom, reversible truss supports, high strength aluminum mounting plates and all stainless steel hardware. Cushcraft Corp., P.O. Box 4680, Manchester, N.H. 03108. (603) 627-7877. Please circle INFO/CARD #136.

Antenna Catalog: Hustler Inc.

A pocket mailer (AM-479) is now available which features an extensive lineup of amateur antennas for fixed

or mobile operation on HF, VHF, and UHF. Also presented are commercial antennas with models for 30-50, 148-174 and 450 to 512 MHz. Hustler Inc., 3275 North B. Ave., Kissimmee, Fla. 32741. (305) 348-5111. Please circle INFO/CARD #130.

Paging Encoders: Reach Electronics

The paging encoder permits two different tone code formats to be used simultaneously. This means, for example, that Reach pagers and Mo-



torola pagers could be paged from the same encoder. Furthermore, when a second code format is employed, the capacity of the encoder is doubled. Thus a 100 code encoder becomes a 200 code encoder for up to 100 Reach

and 100 Motorola pagers. All functions are microprocessor controlled. Reach Electronics, Inc., P.O. Box 308, Lexington, Neb. 68850. (308) 324-6661. INFO/CARD #131.

Analog Multimeter: Soar

The S-20 analog multimeter features a d'Arsonval meter movement, and five function modes — DCV, ACV, DCma, ohms, and dB — as well as twenty measurement ranges. Completely portable (weight 12.6 ounces), the battery-operated S-20 can measure AC and DC voltage from 0 to 1000 volts, DC current from 0 to 250 ma, resistance from 0 to 1 megohm, and dB from -20 to +36. Typical accuracies are ± 3 percent DC and ± 4 percent AC (full scale). Price \$35.00. Soar Electronics, 200 13th Ave., Ronkonkoma, N.Y. 11779. (516) 981-6444. INFO/CARD #132.

Radio: Motorola

The new weather alert radio is designed to monitor both warning tones broadcast by the National Weather Service broadcasting network. The unit is crystal controlled for reliable RF reception and utilizes integrated

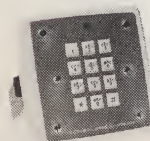
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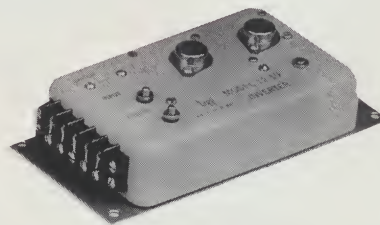
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circuitry for increased reliability. Even in areas where RF interference is present, the FET (field effect transistor) front end provides superior inter-modulation protection and enables the message to get through to the user. A switch on the radio allows it to be operated in either a "monitor" or "alert" mode. In the "alert" mode, the radio operates silently until a severe warning is in effect. The "monitor" mode permits continuous reception of weather forecasts. Motorola, Inc. 2122 Palmer Dr., Schaumburg, Ill. 60195. INFO/CARD #133.

**Instrument Catalog:
B&K-Precision**

The 48-page "BK-80" general line test instrument catalog, features a broad range of high quality test instruments including oscilloscopes, frequency counters, digital and analog multimeters, function and RF signal generators, capacitance meter, digital and pulser probes, semiconductor testers, power supplies, and two-way radio and television test instruments. Each product description includes a detailed specification section and suggested popular applications. Also included is a complete line of instrument probes, connecting cables, carrying cases and other accessories. Available without charge from B&K-Precision, Dynascan Corp., 6460 W. Cortland St., Chicago, Ill. 60635. (312) 889-9087. INFO/CARD #134.

**Hybrid Circuit:
Call Panel: CTI**

The hybrid addition to the CTI dial-page terminal makes possible a two-way conversation from a selectively called radio, direct to the caller on the telephone line. With this talk-back capability, two-way communications is now accomplished from any telephone on the system to any selected RF transceiver unit. The CTI-100SC repeater selective call panel can be used with any RF repeater giving it a selective call capability. By using selective call, the mobile can be equipped with a horn alert relay or other desired functions. Price for the CTI-100SC is \$650. Communications-Transportation, Inc., P.O. Box 1422, Corinth, Miss. 38834. (601) 287-2449. INFO/CARD #118.

**Analyzer; Counter
Hewlett-Packard**

The microwave spectrum analyzer (model 8559A) has a frequency range from .01 to 3 GHz, average noise is -111 dBm/kHz, frequency response is 1.0 dB, and overall amplitude ac-

curacy is 2.3 dB. A five-digit LED readout provides 1 MHz resolution. Model 8559A features the accuracy and sensitivity of a lab grade analyzer, yet its size, weight, and electrical ruggedness also make it useful in field test applications. Price is \$9,600. Option 003 extends model 5315A universal counter's 100 MHz frequency measurement range to 1 GHz. Without extra cost options, the 5315A has measurement functions of frequency, frequency ratio, period, period average, and it will totalize events. Price of option 003 is \$100, and \$800 for model 5315A. Hewlett-Packard Co., 1507 Page Mill Rd., Palo Alto, Calif. 94304. (415) 856-1501. INFO/CARD #138.

**Touch-Tone Microphone:
CES, Inc.**

A touch-tone encoding microphone (model 231) designed especially for the business radio user is now avail-



able. High reliability is achieved by the use of a single contact keyboard. Other features include hang-up button for CTCSS disable, sealed keyboard, and automatic PTT. Available with 500 ohm dynamic or high impedance ceramic cartridge. CES, Inc., 399 W. Fairbanks Ave., Winter Park, Fla. 32789. (305) 647-2712 or (305) 645-0474. Circle INFO/CARD #129.

**Control Head:
Glenayre**

The GL 2010 provides a digital display, 10 stored memory-dial numbers (or multi-digit burst sequences), channel scan, priority channel scanning (during conversation), on-hook dialing, ANI transmission, and a 4-deep memory stack to record the I/D of units calling an unattended vehicle, for automatic callback. The GL 2010 can be adapted to most VHF or UHF radios (simplex or duplex) and is ideal for RCC's, telco maintenance networks, and other utility or fleet users. Glenayre Electronics, 8-12th St., Blaine, Wash. 98230. (206) 285-0470. Circle INFO/CARD #118. ☐

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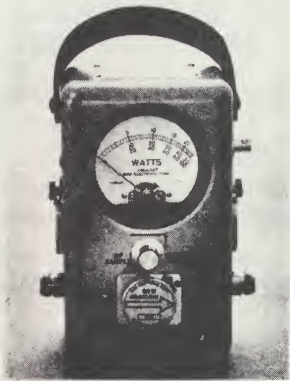


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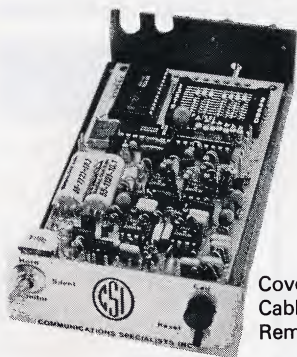


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Literature

High Frequency Antennas; License Manual: American Radio Relay League

Two books, *The ARRL Antenna Anthology* and *The Radio Amateur's License Manual*, have been released. The first is a compilation of antenna construction articles directed toward the beginner and experienced radio amateur interested in maximum performance for minimum expense. The second is a study guide that includes a completely indexed set of the rules and regulations governing all modes of Amateur Radio operation. Each are priced at \$4.00. ARRL, 225 Main, Newington, Conn. 06111. (203) 666-1541. INFO/CARD #111.

Major Matters: FCC

The Federal Communications Commission's Annual Report on Major Matters is now available for public distribution. The report is prepared to keep Congress, the public, and the Commission's staff informed of pending proceedings that the Commission considers to be of major significance. Copies are available from the Office of Public Affairs, 1919 M St., Room 202, Washington, D.C. 20554. (202) 632-7260.

Report: NTIA

—Program for Control of Electro-
magnetic Pollution of the Environ-

ment: *The Assessment of Biological Hazards of Nonionizing Electromagnetic Radiation* (NTIA Report 79-19) summarizes the Federal Government's research program on biological effects of non-ionizing electromagnetic radiation. It describes ongoing research in ten Federal agencies and in other institutions, highlighting the more significant directions being taken in this research. Publications pertinent to these research activities and to agency projects for 1977 and 1978 are cited. A limited number of copies may be obtained from Office of the Chief Scientist, NTIA, U.S. Department of Commerce, 1800 G St., NW, Room 760, Washington, D.C. 20504. (202) 377-1850.

Radio Permit Handbook: Howard W. Sams & Co.

The Broadcast and Two-Way Radio Operators Permit Handbook (ISBN: 0-672-21627-2) provides the information needed by the restricted radiotelephone permit holder and the third-class radiotelephone operator. While many broadcast and two-way radio operators are not required to have a technical knowledge of the equipment, they must have a knowledge of radio law, including the FCC Rules and Regulations and the basic operating procedures. Soft-bound copies, 176 pages, are \$6.50. Howard W. Sams & Co., Inc., 4300 W. 62nd St., P.O. Box 558, Indianapolis, Ind. 46206. (317) 298-5400. INFO/CARD #112. □

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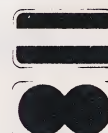
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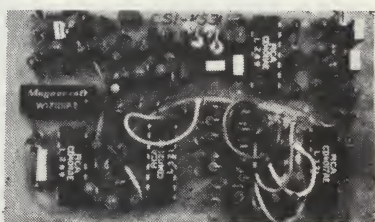
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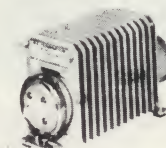
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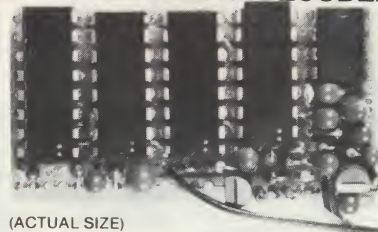
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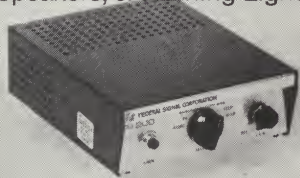
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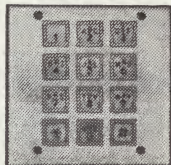
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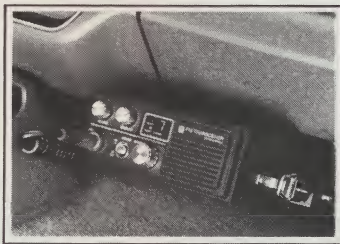
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